

iMac (2019) Overview

Scope of this Document

The [iMac \(Retina 4K, 21.5-inch, 2019\)](#) and [iMac \(Retina 5K, 27-inch, 2019\)](#) Service Guides provide troubleshooting steps, take-apart procedures, and other information for these iMac models only. Separate service guides cover other iMac models.

Overview Contents:

- Features
- Service Considerations
- New Tools
- Serial Number Location
- Diagnostic Software
- Recovering a Lost Firmware Password
- Reinstalling Software That Came With the Computer



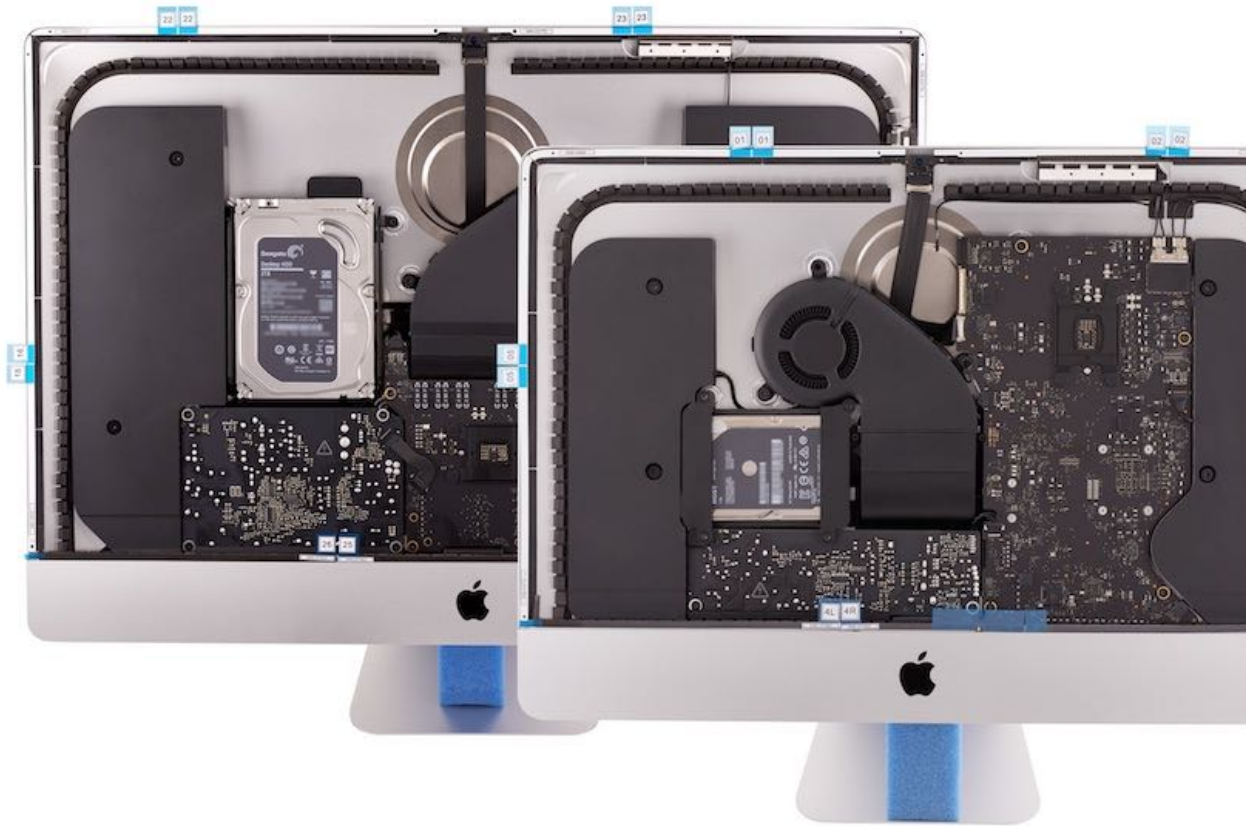
Features

- Processors: 2.3GHz dual-core Intel Core i5, configurable to 3.6GHz 8-core Intel Core i9 (Turbo Boost up to 5.0GHz)
- Graphics: Intel Iris Plus Graphics 640, configurable to Radeon Pro Vega 48 with 8GB of VRAM
- I/O Ports:
 - SDXC card slot
 - Four USB 3 ports
 - Two Thunderbolt 3 (USB-C) ports
 - 10/100/1000BASE-T Gigabit Ethernet (RJ-45 connector)
- [Tech Specs](#)

Service Considerations

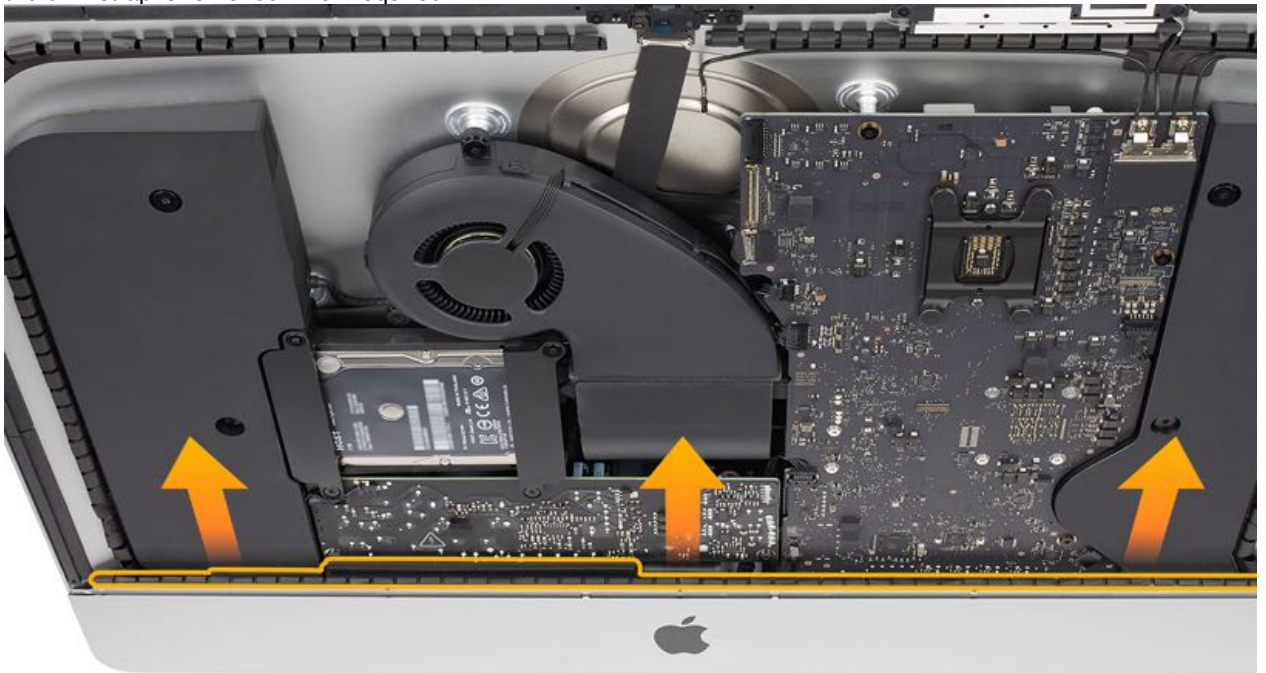
- **Shared procedures:**

- Some of the procedures are shared between iMac (Retina 4K, 21.5-inch, 2019) and iMac (Retina 5K, 27-inch, 2019). Images in these shared procedures may show one model but the steps to perform the repair are the same for both.



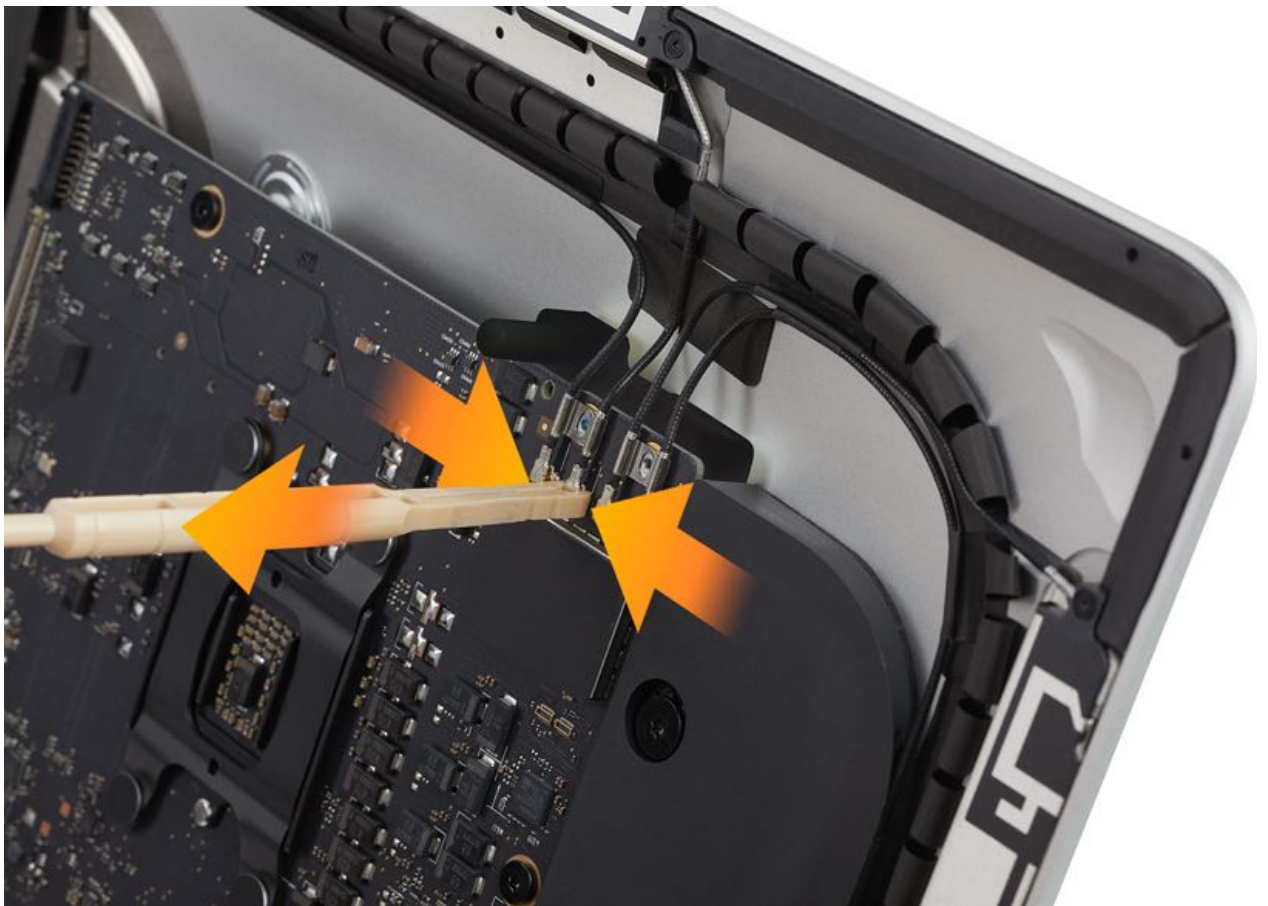
- **Chin strap:**

- Removal of the chin strap has been integrated into the first removal steps of several procedures to ensure that the chin strap is removed when required.

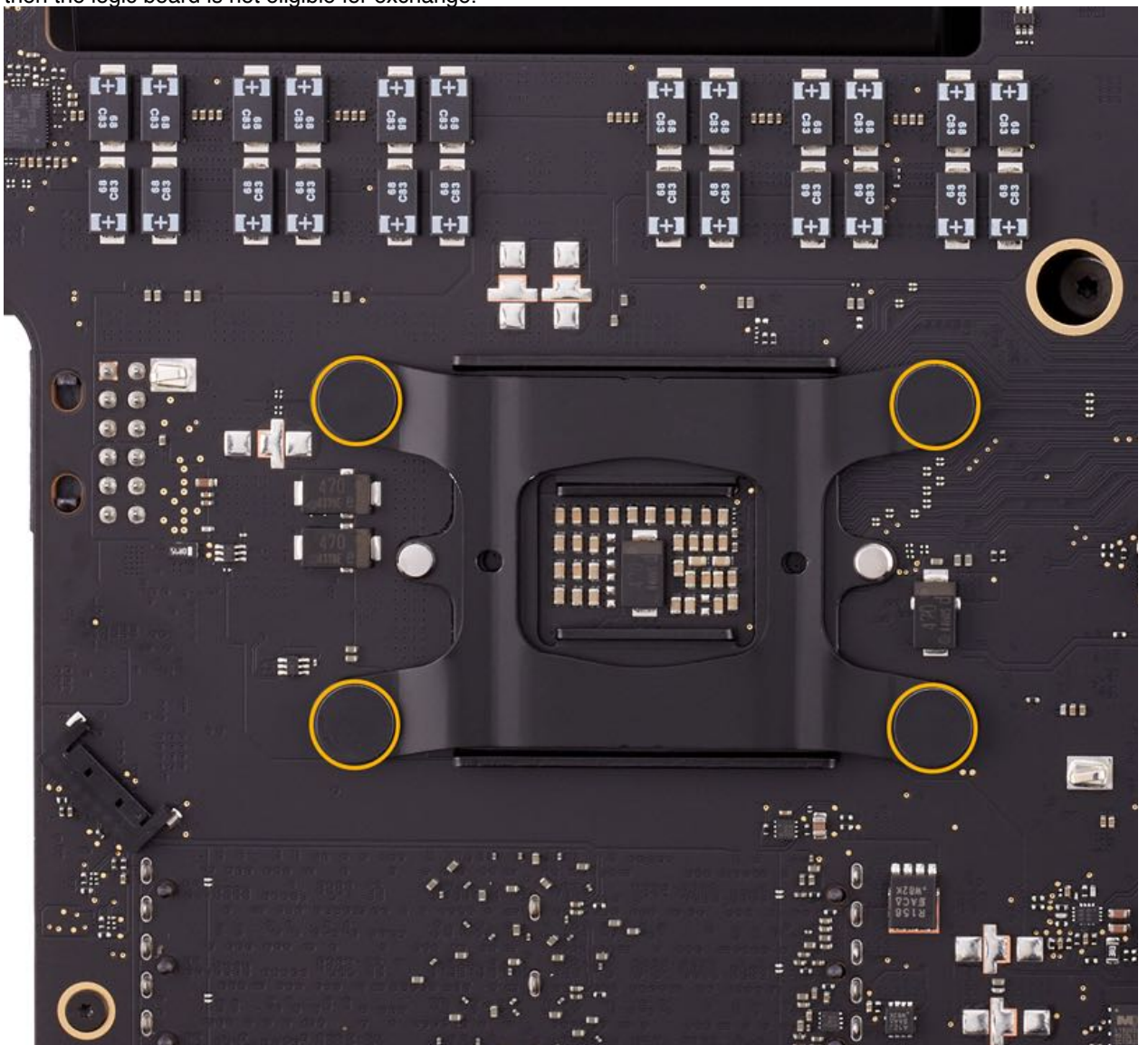


- **Logic board:**

- The wireless card is integrated with the logic board for both models. Use caution when disconnecting and reconnecting the antennas. If the antenna connectors are damaged, a logic board replacement is required.

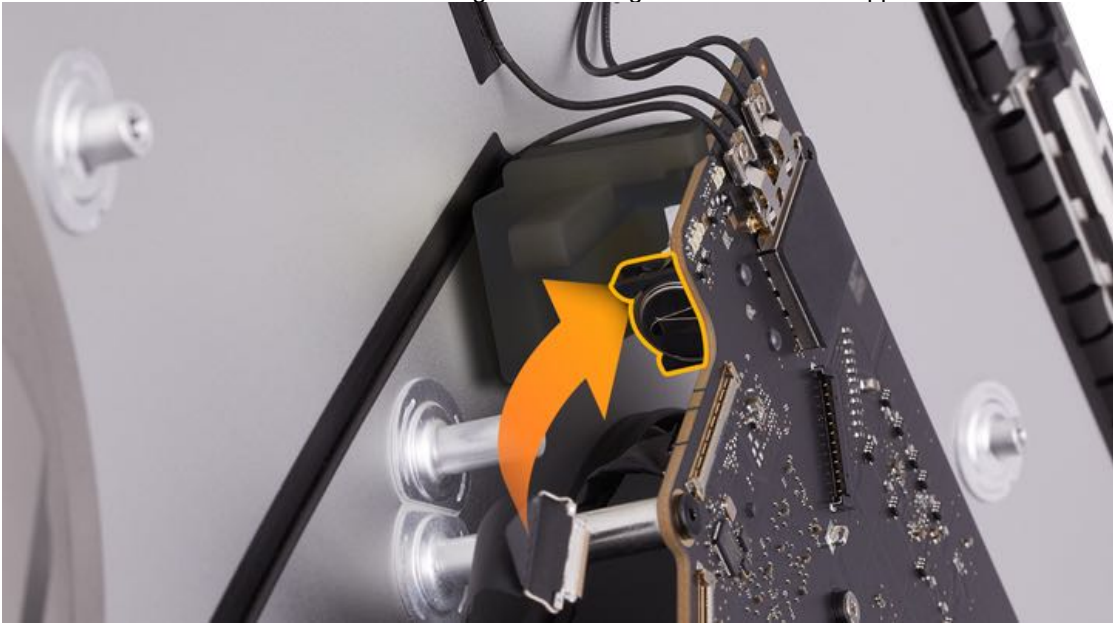


- Verify that the tamper indicator labels on the heat sink are intact. If labels have been removed or tampered with, then the logic board is not eligible for exchange.



- **Coin cell battery:**

- The coin cell battery on the iMac (Retina 5K, 27-inch, 2019) logic board is positioned vertically near the integrated wireless card. Use extra care when inserting and removing the wireless card support tool.



- **NetBoot:**

- NetBoot is not available for these models. For instructions on reinstalling the OS, follow the steps in [HT204904: How to reinstall macOS from macOS Recovery](#).

New Tools

- Wireless card support tool for iMac (Retina 4K, 21.5-inch, 2019)
 - **923-03086**



- Wireless card support tool for iMac (Retina 5K, 27-inch, 2019)
 - **923-03085**



Serial Number Location

The serial number is located on the bottom of the stand.

Note: If the computer has a VESA mount, then the serial number is located on the underside of the VESA mount tongue.



Diagnostic Software - Apple Service Toolkit 2 (AST 2)

AST 2 is a cloud-based diagnostic system to help technicians triage and verify repairs for Mac computers. With AST 2, technicians are able to initiate diagnostics wirelessly on a user's device using Diagnostic Console (a web application on a Mac or iPad). Technicians are also able to view diagnostic results in Diagnostic Console.

For more information, refer to the following articles:

- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [TP1105: AST 2 for Mac Reference Guide - Table of Contents](#)
- [TP1118: AST 2 for Mac Reference Guide - Table of Contents \(Retail\)](#)
- [HT202731: How to use Apple Diagnostics on your Mac](#)

Recovering a Lost Firmware Password

Only technicians at Apple Stores or Apple Authorized Service Providers can unlock these iMac models when they are protected by a firmware password. Refer to the technician instructions in [HT204455: How to set a firmware password on your Mac](#).

Reinstalling Software That Came with the Computer

This procedure requires an Internet connection.

Note: In some situations, a user may have set a firmware password. The user must know the firmware password in order to reinstall macOS. If the user cannot remember the password, then refer to the technician instructions in [HT204455: How to set a firmware password on your Mac](#).

Important: Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing macOS. Apple is not responsible for any loss of data. For instructions on using Time Machine, refer to [HT201250: Backup your Mac with Time Machine](#).

For instructions on reinstalling the OS, follow the steps in [HT204904: How to reinstall macOS from macOS Recovery](#).

For more information about recovery mode, refer to [HT201314: About macOS Recovery](#).

General Troubleshooting

Update Software and Firmware

Important: Before troubleshooting, ensure the correct version of macOS is installed, and check for and apply the latest software and firmware updates. Computers sometimes exhibit symptoms that indicate the incorrect version of macOS is installed. Refer to [HT201686: Use the Mac operating system that came with your Mac, or a compatible newer version](#) to make sure system build is correct for this computer model.

Firmware refers to software that is written into memory circuits such as flash memory, which will hold the software code indefinitely, even when power is removed from the hardware. Firmware on Intel-based Mac computers prior to computers with an Apple T2 Security Chip is designed to be updated if necessary by running macOS Software Update (available in the Apple () menu under About This Mac) while the computer is connected to the Internet.

For computers with an Apple T2 Security Chip, separate SMC and EFI firmware images have now both been integrated into bridgeOS.

Troubleshooting Techniques

For more information, go to [ATLAS](#) and enter “troubleshooting” in the search field.

Hardware versus Software

To isolate a hardware issue from a software issue, refer to [HT203161: Isolating issues in macOS](#).

To troubleshoot a software issue, refer to the following articles:

- [HT201516: How to troubleshoot a software issue](#)
- [HT201861: About incompatible software on your Mac](#)
- [HT204323: If a flashing question mark appears when you start your Mac](#)
- [HT204904: How to reinstall macOS from macOS Recovery](#)
- [HT202574: About Fusion Drive, a storage option for some Mac computers](#)

Quick Check Procedures

System Configuration for Macs with the Apple T2 Security Chip

Important: For Macs with the Apple T2 Security Chip, the repair process is not complete for certain part replacements until the AST 2 System Configuration suite has been run. Failure to perform this step will result in an inoperative system and an incomplete repair.

- [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#)
 - For MacBook Pro (2018 and 2019): Display assembly, logic board, top case, and Touch ID board
 - For MacBook Air (Retina, 13-inch, 2018): Logic board and Touch ID board
 - For iMac Pro: Logic board and flash storage
 - For Mac mini (2018): Logic board

Resetting the System Management Controller (SMC)

The System Management Controller (SMC) is a chip on the logic board that controls all power functions. On some Mac computers, the Apple T2 Security Chip integrates several controllers—such as the SMC, image signal processor, audio controller, and SSD controller. If the computer is experiencing any power issue, such as not starting up, not displaying video, sleep issues, or fan noise issues, resetting the SMC may resolve it.

For more information and instructions to reset the SMC on different computer models, refer to [HT201295: How to reset the System Management Controller \(SMC\) on your Mac](#).

Note for iMac: If the power button is pressed while the power cord is being inserted, the iMac will enter a mode that runs the fans at full speed. For more information, refer to [HT204463: If the fans in your Mac run at full speed when you turn it on](#).

Note for iMac Pro (2017): If the power button is pressed while the power cord is being inserted, the iMac will enter Device Firmware Upgrade (DFU) mode and will need to be restored.

Resetting Nonvolatile RAM (NVRAM)

NVRAM stores certain system and device settings in a location that macOS can access quickly. Exactly which settings are stored in the computer's NVRAM varies depending on the type of computer, connected devices, and drives. To reset NVRAM:

For information, refer to [HT204063: Reset NVRAM or PRAM on your Mac](#).

Starting Up in Safe Mode

Safe mode (sometimes called safe boot) is a way to start up a Mac so that it performs certain checks and prevents some software from automatically loading or opening. These changes can help resolve or isolate certain issues on the startup disk.

For information, refer to [HT201262: Use safe mode to isolate issues with your Mac](#).

iMac (Retina 5K, 27-inch, 2019) Diagnostic LEDs and Test Pads

Diagnostic LEDs and Test Pads for iMac (Retina 5K, 27-inch, 2019)



Warning: HIGH VOLTAGE. Be extremely careful when working inside the computer while power is applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Be very careful not to touch tools to logic board components other than the test pads.

After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.

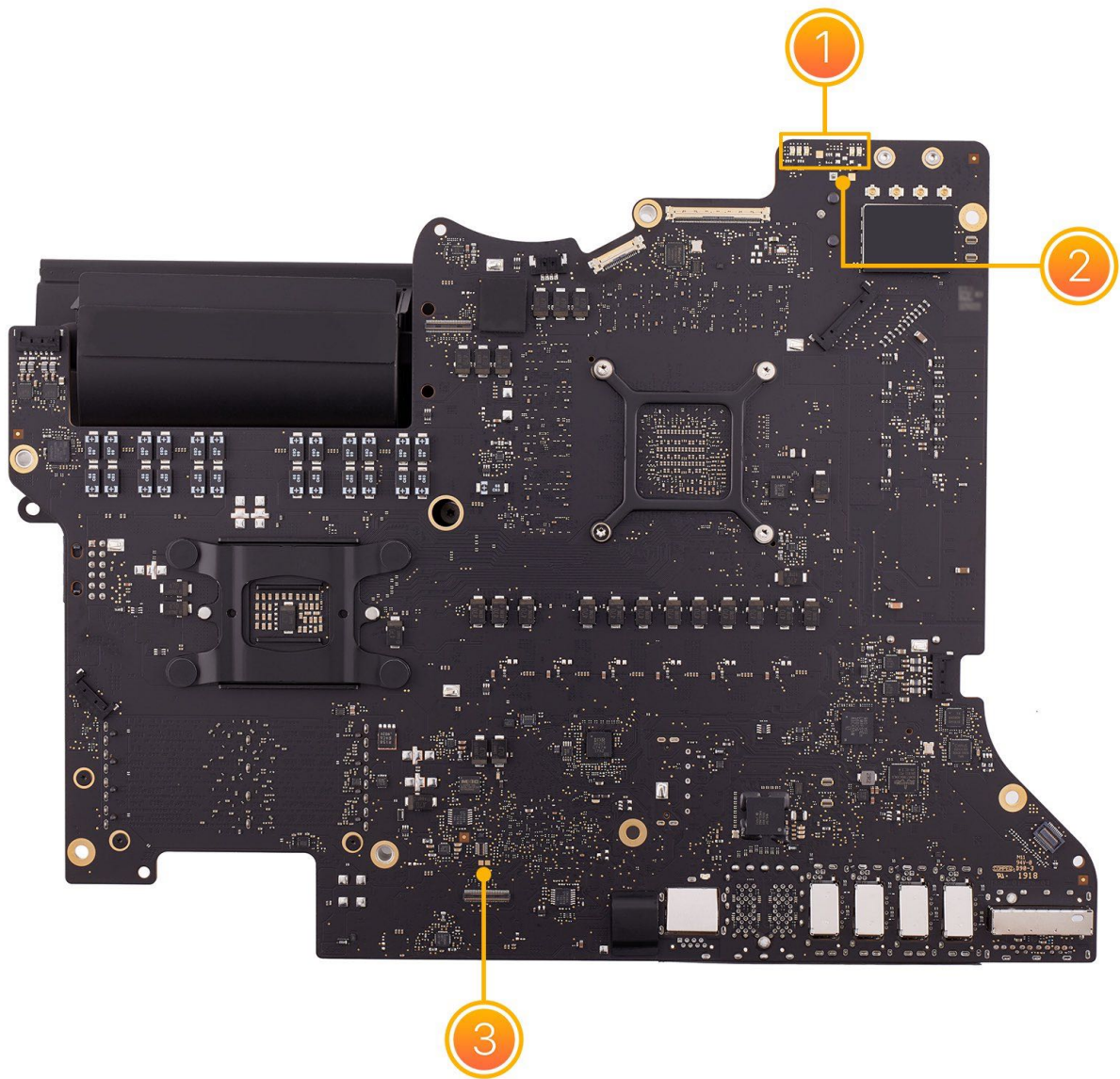
Refer to the following articles for more information:

- [TP833: iMac and Displays: Power Supply Cover Instructions](#)
- [TP820: iMac \(27-inch\): Safety](#)

The iMac (Retina 5K, 27-inch, 2019) model has five diagnostic LEDs (1) and two pairs of test pads (2 and 3) that can help you troubleshoot the computer without removing the logic board.

The coin battery, located on the back of the logic board, provides power to the real-time clock (RTC) and nonvolatile random-access memory (NVRAM) when the computer is not connected to an AC power source. The RTC maintains the date and time, while the NVRAM stores information such as speaker volume, screen resolution, startup disk selection, and recent kernel panics. The coin battery is designed to last several years and does not normally require replacement. However, if there are issues with the functions listed above, the RTC and NVRAM may need to be reset or the coin battery may need to be replaced.

Click on the following image to enlarge.

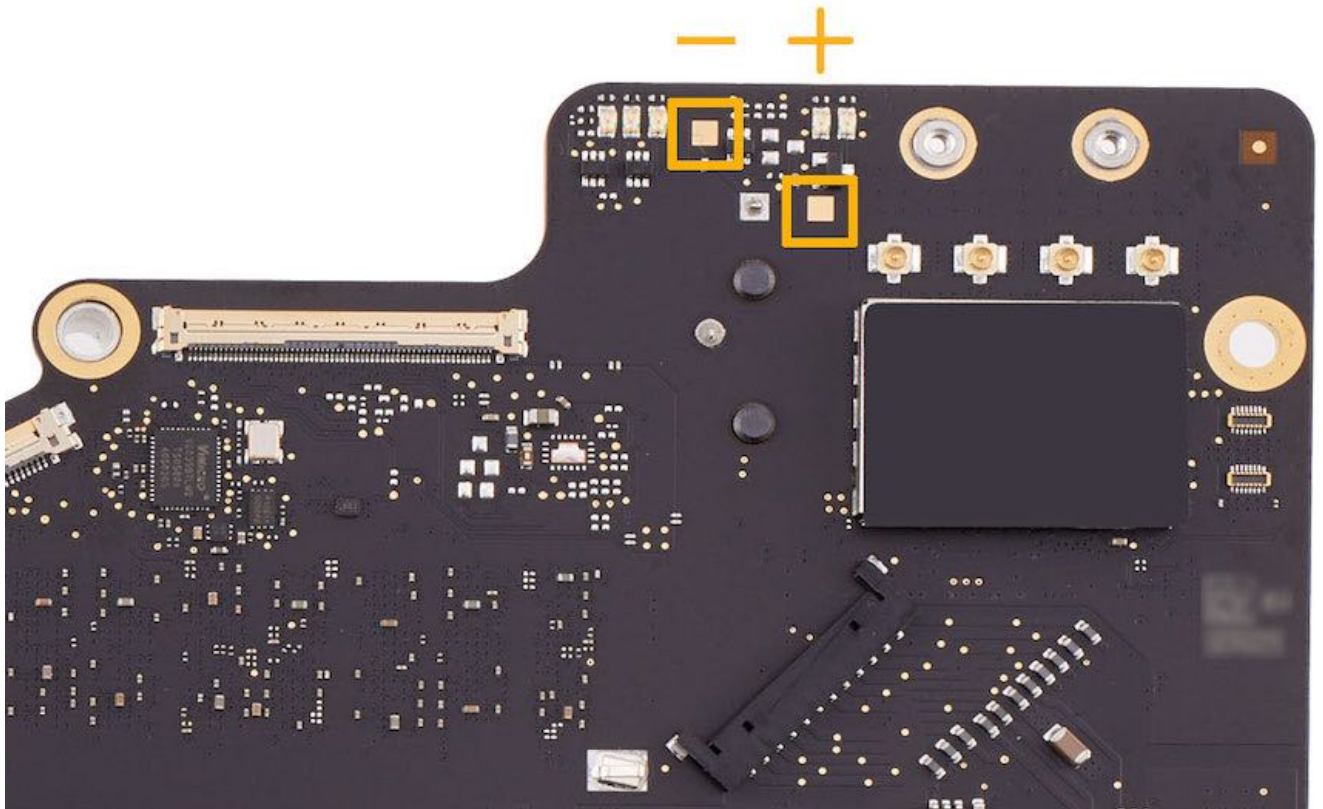


1. **Diagnostic LEDs**

- See the full description of LED behaviors at the bottom of this article.

2. **Coin Battery Voltage Test Pads**

- Shut down and unplug the iMac. Allow approximately two minutes for the power supply to discharge.
- Measure the coin battery voltage by using a voltmeter set for DC. Place the probes on the pads. If the voltage is 2.7 volts DC or less, then the coin battery should be replaced.
(-) **negative** (same as chassis ground)
(+) **positive**

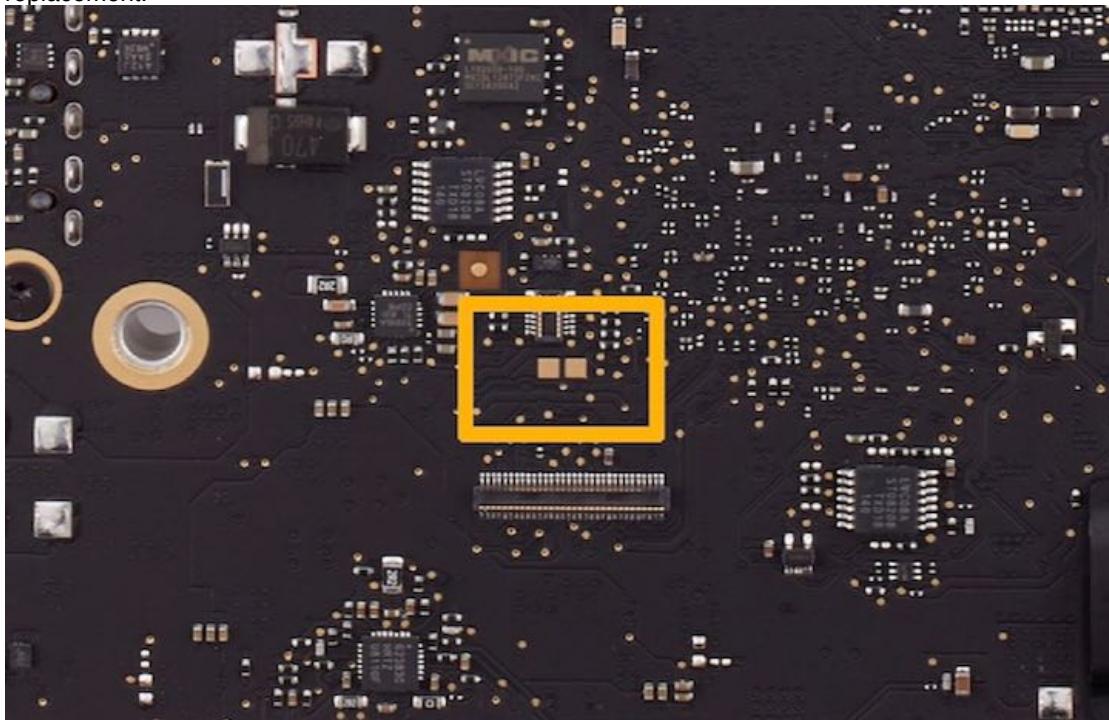


3. Real-Time Clock (RTC) Reset Pads iMac (Retina 5K, 27-inch, 2019)

- Shut down and unplug the iMac. Allow approximately two minutes for the power supply to discharge.
- Reset the RTC by shorting the pads in location C, shown below. Use the tip of a flat-blade screwdriver to touch both pads at the same time.



Caution: Do not make contact with any of the surrounding components or traces while performing this procedure. Some of the smaller components can be broken off very easily. Physically damaged boards warrant a logic board replacement.



Diagnostic LEDs

LED 1

- Indicates that the trickle voltage from the power supply has been detected by the main logic board. This LED will turn on when you connect the iMac to a working AC power source. The LED will remain on as long as the computer is on or asleep.
- When the computer has been shut down correctly, LED 1 behavior may differ:
 - If a startup event is scheduled in System Preferences/Energy Saver, then LED 1 will stay on after a correct shutdown.
 - If no startup event is scheduled in System Preferences/Energy Saver, then LED 1 will turn off and will stay off as long as the power cord is kept connected and an AC power source is present. Disconnecting the power cord and plugging it back in will turn this LED back on, even if the computer is still off.
- After disconnecting and reconnecting the AC power source, this LED could remain off:
 - If the AC power source is missing or disconnected.
 - If the logic board is disconnected from the power supply or the AC receptacle.
 - If the power supply board is faulty.

LED 2

- Indicates that the computer is turned on. This LED will be on as long as the computer is turned on (but is not asleep) and the power supply and voltage regulators are working correctly.

LED 3

- Indicates that the logic board and GPU are communicating. This LED will be on when the CPU is communicating properly with the GPU. If LEDs 1 and 2 are on and LED 3 is off, then the backup battery (on the back of the logic board) may need to be reseated or the logic board may need replacement.

LED 4

- Indicates that the logic board and LCD panel are communicating. This LED will be on when the computer is turned on and a video signal is being generated. If LED 4 is on and there is no image on the display, then the LCD panel or the cables between the LCD and logic board might be installed incorrectly or need replacement.

LED 5

- Indicates that the logic board and LCD panel are communicating. This LED is on when the computer is turned on, a video signal is being generated, and the LCD Panel is signaling to turn on the backlight. If LED 5 is ON and there is no image on the display, then the LCD backlight or circuitry on the logic board may be malfunctioning. The LCD panel or the cables or the logic board may need replacement.

LED Startup Sequence

LED 1 = Power is available.

If no LED is visible:

- Disconnect the power cord from the computer and wait 15 seconds to reset the power supply and LED status. Reconnect the power cord and check the LED status again.
- Verify the AC source.
- Verify that a known-good power cord is connected.
- Verify the cable connection between the AC inlet and the power supply.
- Verify the cable connection between the power supply and the logic board.
- Verify the power supply.

LED 1 + LED 2 = Power is available and the system is turned on.

If the second LED is not visible when the power button is pressed:

- Verify that the power button is connected to the power supply.
- Verify power button functionality.
- Verify the cable connection between the power supply and the logic board.
- Verify the power supply.
- Verify the logic board.

LED 1 + LED 2 + LED 3 = Power is available, the system is turned on, and the GPU was found.

If the third LED is not visible after the system is turned on:

- Verify whether the fan is running when turned on (reset SMC and NVRAM, verify backup battery voltage for proper startup).
 - If the fan is not heard, go to the "No Startup" troubleshooting flow.

LED 1 + LED 2 + LED 3 + LED 4 = Power is available, the system is turned on, the logic board is communicating with the GPU, and the internal LCD was found.

If the fourth LED is not visible after the system is turned on:

- Verify the embedded DisplayPort cable (eDP) connections between the LCD panel and the logic board.
- Inspect the LCD display cables for cable damage.
- Verify external video functionality and proceed according to the result:
 - If an external display works, verify/replace the LCD panel.
 - If an external display does not work, verify/replace the logic board.

LED 1 + LED 2 + LED 3 + LED 4 + LED 5 = Power is available, system is turned on, GPU is working, logic board is communicating with the LCD panel, and the LCD panel has turned on the LCD backlight.

If the fifth LED is not visible after the computer is turned on:

- Verify the eDP cable and backlight cable connections between the LCD panel and the logic board.
- Inspect the LCD display cables for cable damage.
- Using a flashlight, check the following areas on the panel:
 - Look in the top left corner of the panel to see if there is a dim Apple logo (the Apple menu logo).
 - Look in the center of the panel to see if there is a login screen.
 - Look at the bottom of the panel to see if there is a Dock visible.
 - If the following items are visible, there may be something wrong with the display cables or the logic board. Proceed to the next step.
- Replace the LCD panel, check that all the LEDs are visible, and that the backlight functions. If the computer does not function after replacing the LCD panel, replace the logic board.

Testing the Panel Using the Display Extension Cable Kit

Testing the Panel Using the Display Extension Cable Kit for iMac (27-inch, Late 2012–2019) and iMac Pro (2017)

Use the display extension cable kit to:

- Test the system and/or panel before securing the panel to the very high bond (VHB) adhesive strips.
- Test the functionality of the panel's Embedded DisplayPort (eDP) cable.



Warning: HIGH VOLTAGE. Use extreme caution when troubleshooting with the display panel removed. Avoid touching the logic board or power supply while the computer is plugged in, the power supply retains a charge whether or not the computer is on.

After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.

- Never remove or install any physical components while the computer is plugged in to an electrical outlet.
- When plugged in, the power supply and logic board are energized, even when the computer is turned off.
- Unplug the computer and allow sufficient time for the power supply and logic board to self-discharge before removing the display panel.
- Do NOT touch the logic board or the power supply while the computer is plugged in, or before sufficient time has passed to discharge stored voltage to a safe level after being unplugged.

Refer to the following articles for more safety information:

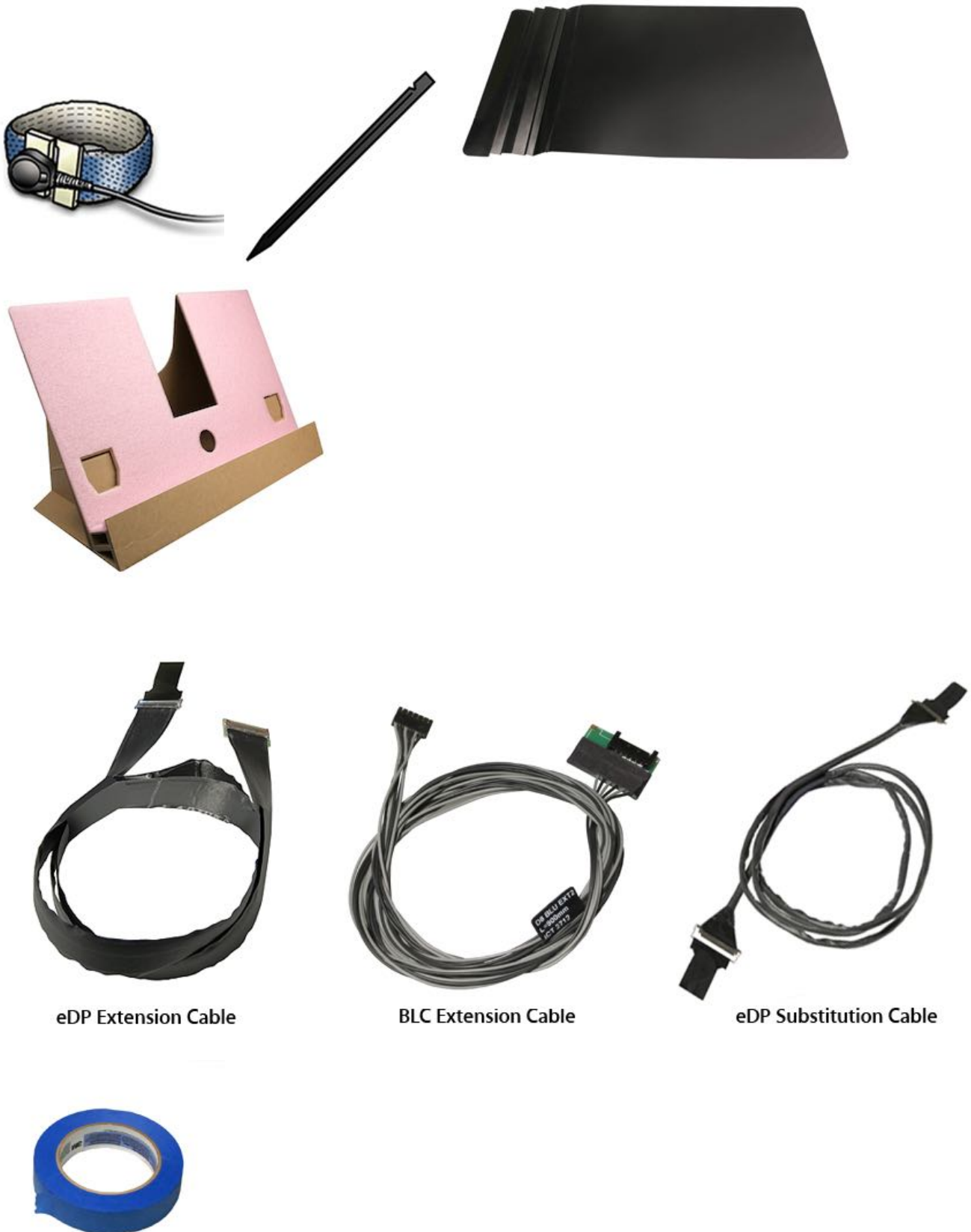
- [TP833: iMac and Displays: Power Supply Cover Instructions](#)
- [TP820: iMac \(27-inch\): Safety](#)
- [TP1620: iMac Pro \(2017\): Power Supply Cover Instructions](#)
- [TP1637: iMac Pro \(2017\): Safety](#)



Tools

- ESD wrist strap and mat
- Black stick
- Power supply protective covers, pack of two (923-0189)
- LCD service support stand, iMac (923-0416)
- Kit, display extension cable set (076-1431) for iMac (27-inch, Late 2012 and Late 2013)

- Kit, display extension cable set (076-00010) for iMac (Retina 5K, 27-inch, Late 2014–2019)
- Kit, display extension cable set (076-00373) for iMac Pro (2017)
- Painter's tape



eDP Extension Cable

BLC Extension Cable

eDP Substitution Cable

Note: The iMac (27-inch, Late 2013) display and extension cable kit are shown for the procedures. Follow the same setup steps and procedures if testing the iMac (Retina 5K, 27-inch, Late 2014–2019) display or the iMac Pro (2017), but use the correct kit for each.

- iMac (Retina 5K, 27-inch, Late 2014–2019): 076-00010
- iMac Pro (2017): 076-00373

Procedure #1: Testing the System With the Panel Off, Using Extension Cables

This procedure allows you to test the system with the panel off in order to ensure everything is functioning before securing the panel with very high bond (VHB) adhesive strips.

First Steps

For iMac (27-inch, Late 2012–2017):

- [Display panel removal](#)
- [Display panel - removing very high bond \(VHB\) strips](#)

For iMac (Retina 5K, 27-inch, 2019)

- [Display removal](#)
 - Includes display adhesive (VHB) removal

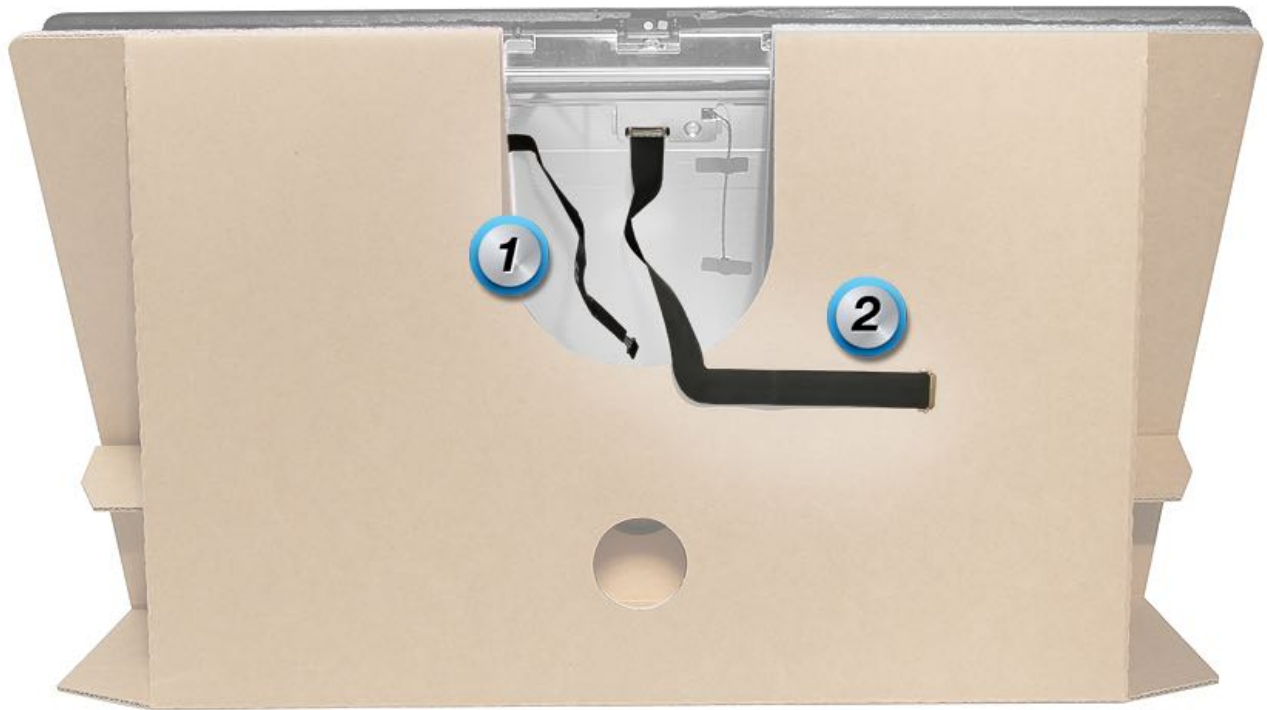
For iMac Pro (2017):

- [Display panel removal](#)
- [Display panel - removing very high bond \(VHB\) strips](#)

1. Place the LCD panel on the service support stand.



2. Orient the service support stand so the LCD backlight cable (#1) and eDP (#2) cable are facing you.



3. Locate the eDP extension cable in the kit.



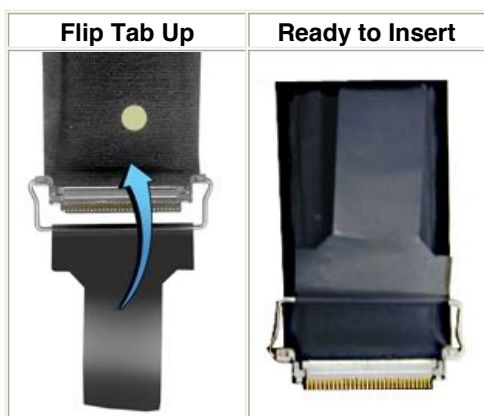
4. Either end of the eDP extension cable can connect to the logic board; the other end connects to the display.

Important: Each end of the eDP extension cable has a gold dot to indicate cable orientation. Orient the cable with the gold dot side up when connecting the eDP extension cable to the logic board connector and the end of the LCD eDP cable. Connecting cables upside down (with the brass connector facing up) will damage the logic board and/or the LCD panel.

Note: With proper care, cables will last for approximately 50 insertions. After 50 insertions, cable degradation may occur and Apple recommends ordering a new Display Extension/Substitution Cable Kit (refer to the Tools section above).

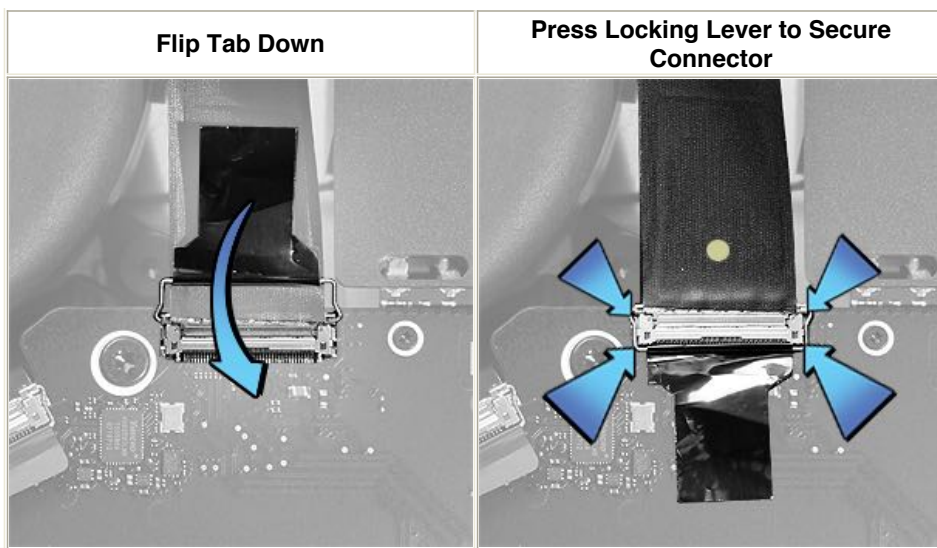


5. Flip the black tab up before connecting the eDP extension cable to the logic board connector.

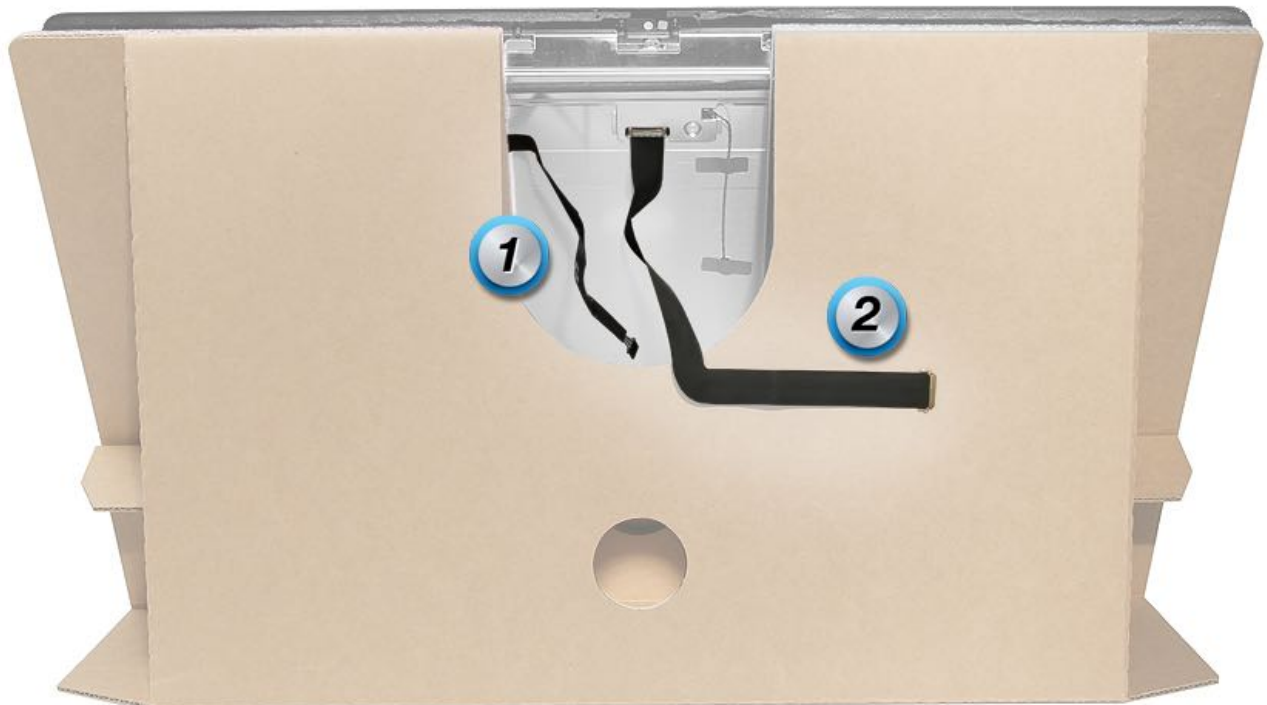


6. With the iMac unplugged, connect the extension cable to the logic board connector. The cable should be aligned straight on with the connector and never inserted at an angle. **Important:** Ensure that the black tab is attached to the locking lever on the eDP cable. Attaching the locking lever without the black tab may cause damage to the logic board and/or the LCD panel.

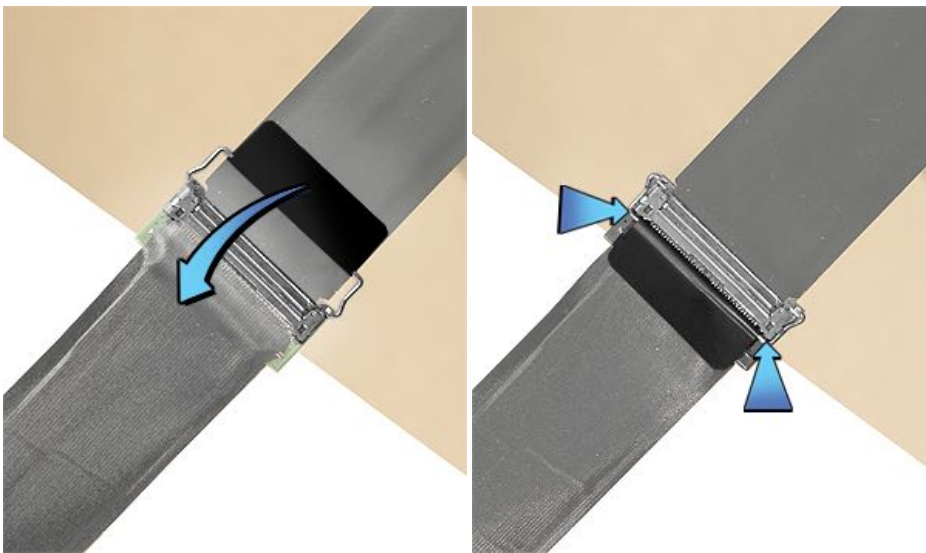
- Verify that each end of the cable has the gold dot side up.
- Check that the connector is fully seated.
- Flip the black tab down.
- Press the locking lever to secure the cable to the logic board.



7. Secure the logic board end of the eDP extension cable to the speaker with painter's tape (see step 10).
8. Connect the other end of the eDP extension cable to the end of the dangling DisplayPort cable (#2).



9. Securely mate the cable connectors. Flip the black tab over and press the locking lever bar around the connector to secure the cables.



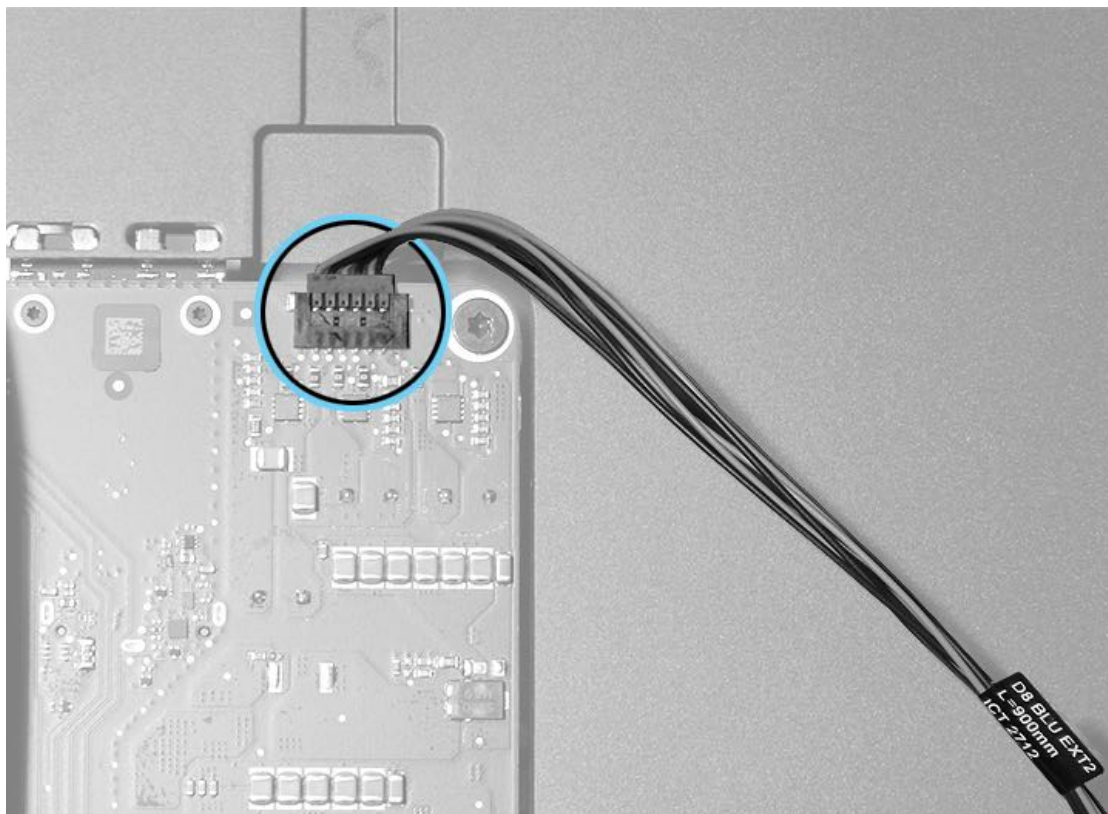
10. The eDP extension cable will look like the image below when connected properly.



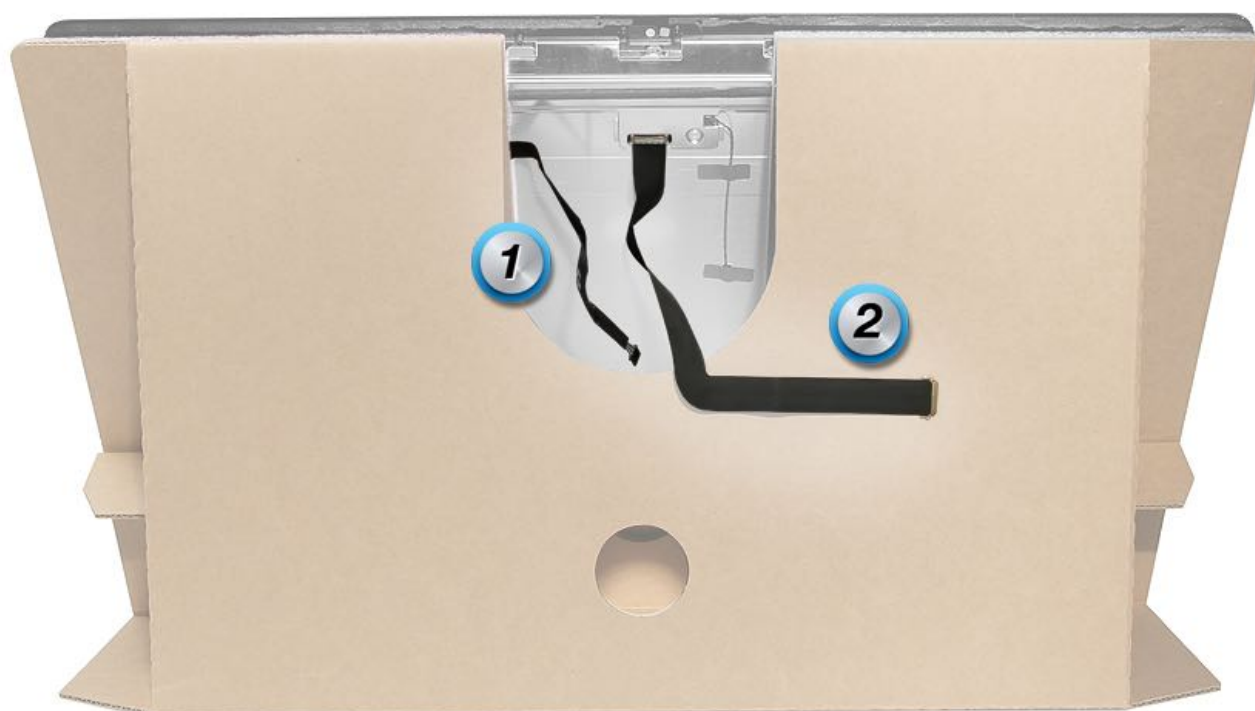
11. Next, locate the backlight extension (BLC) cable.



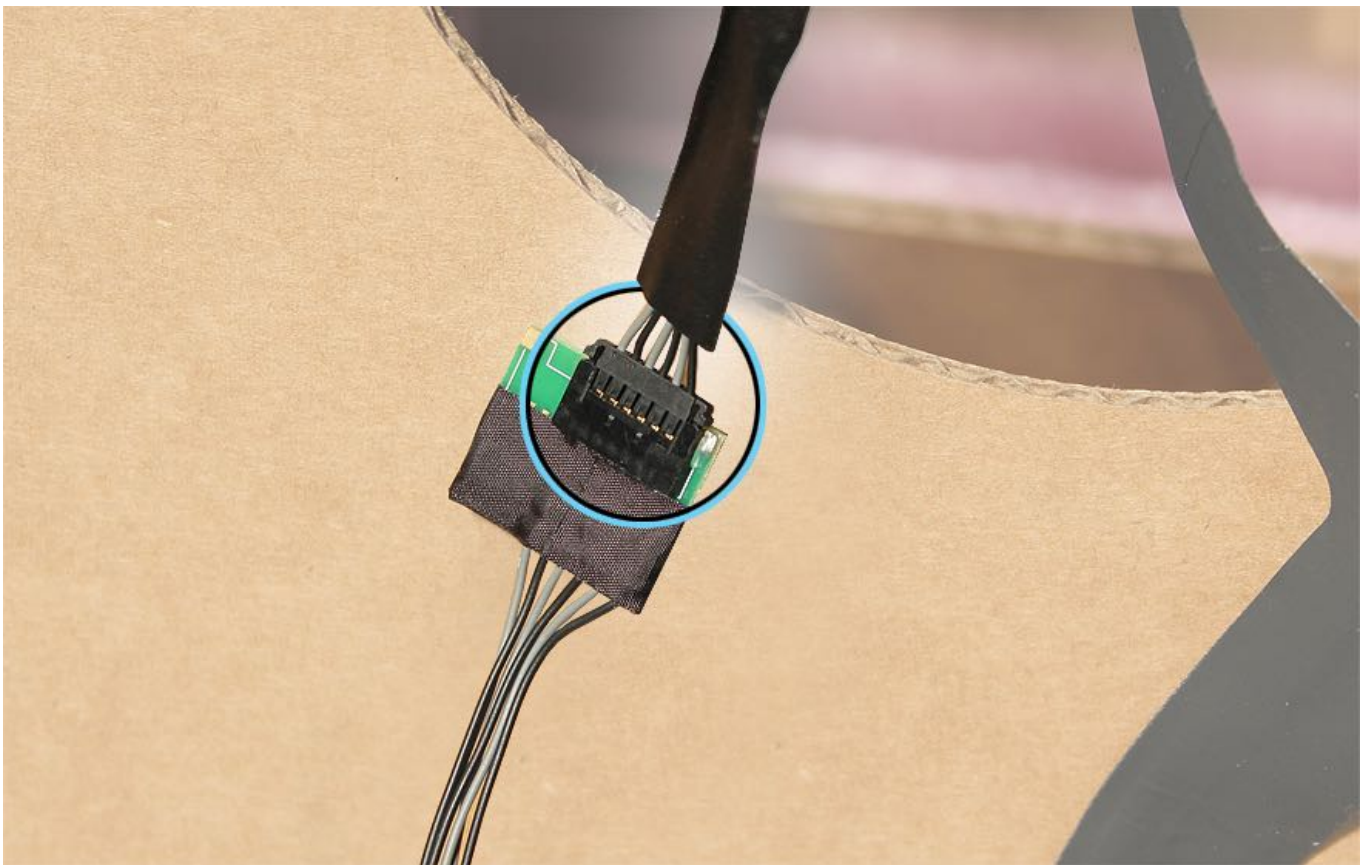
12. With the iMac unplugged, connect the backlight extension cable to the backlight connector on the logic board.



13. Connect the other end of the backlight extension cable to the dangling end of the LCD backlight cable (#1).

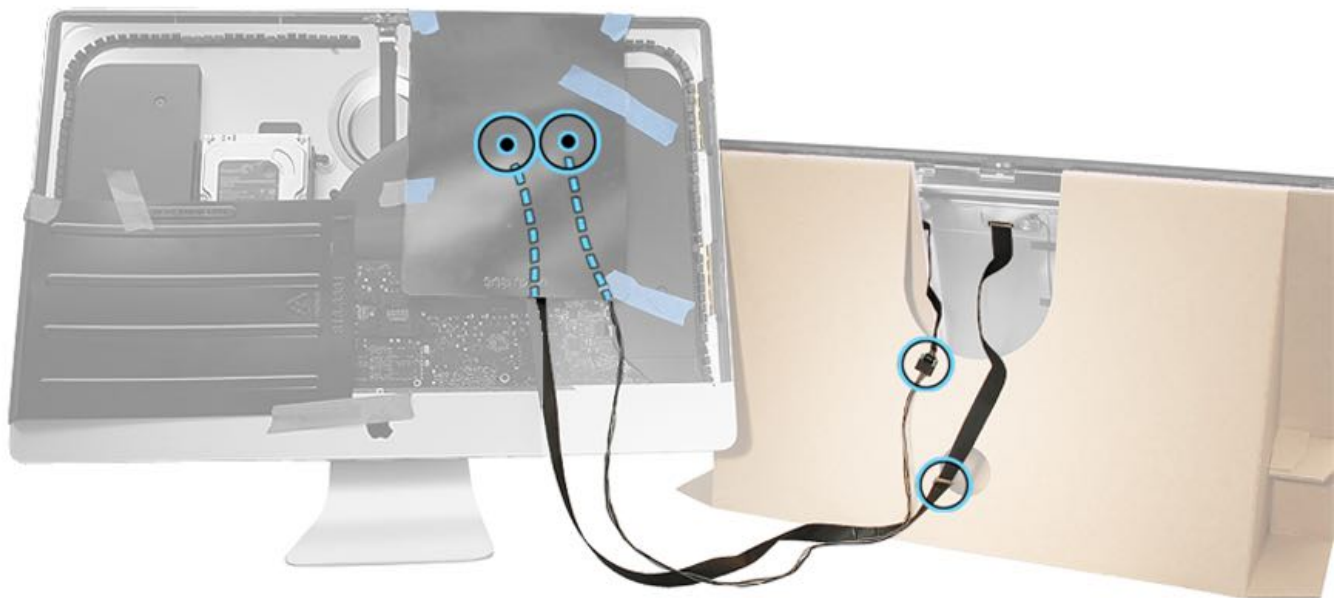


14. Securely mate the backlight extension cable with the panel's backlight cable connector.



15. Locate the two power supply covers. With the iMac unplugged, position one horizontally over the power supply and one vertically over the logic board and cables. Tape the power supply covers securely to the rear housing. Proper eDP and backlight extension cable setup is shown below.

16. Attach the power cord to the iMac and start up the system to verify system functionality.



Procedure #2: Testing the Panel with the eDP Substitution Cable

This procedure tests an eDP cable to determine whether the issue is with the eDP cable. Remove the “suspect” eDP cable from the circuit and replace it with the eDP substitution cable.

First Steps

For iMac (27-inch, Late 2012 – 2019):

- [Display panel removal](#)
- [Display panel - removing very high bond \(VHB\) strips](#)

For iMac (Retina 5K, 27-inch, 2019)

- [Display removal](#)
 - Includes display adhesive (VHB) removal

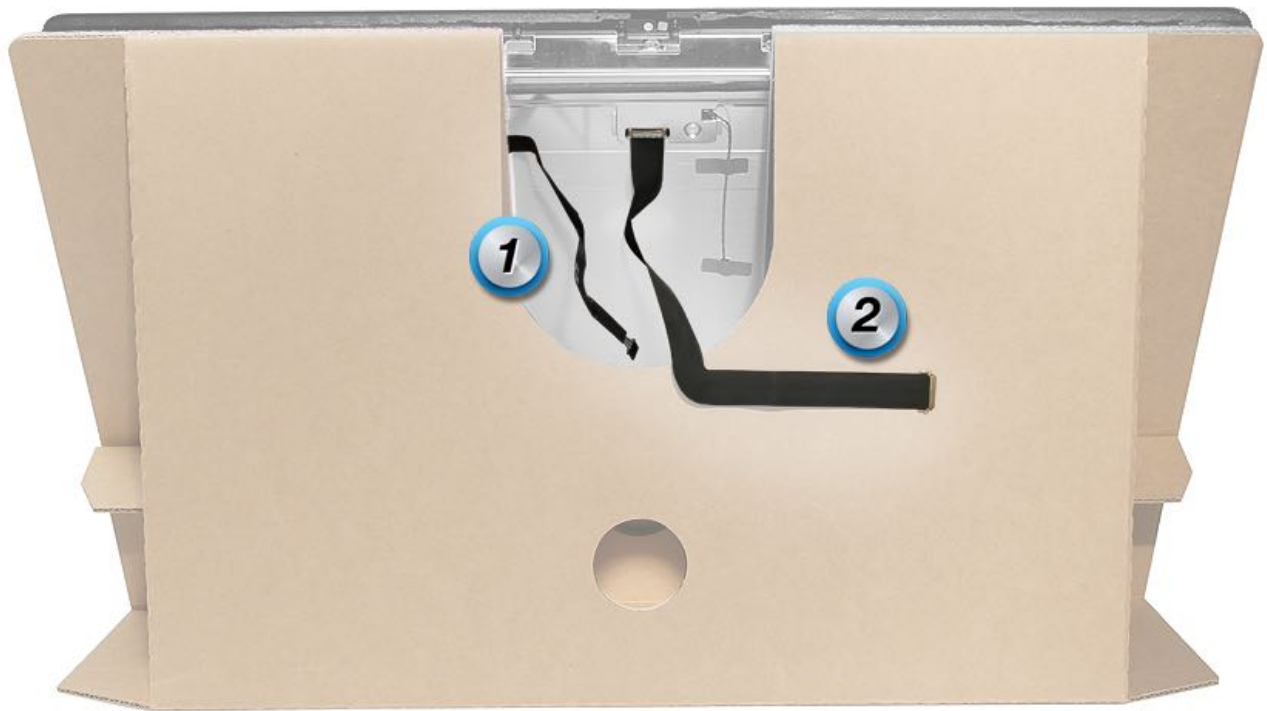
For iMac Pro (2017):

- [Display panel removal](#)
- [Display panel - removing very high bond \(VHB\) strips](#)

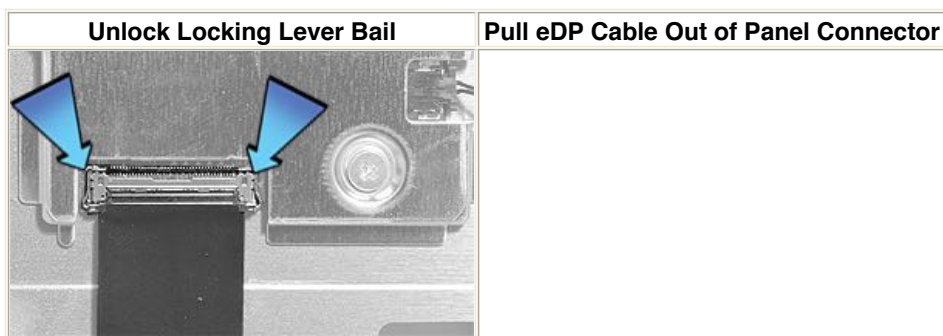
1. Place the LCD panel on the service support stand.



2. Orient the service support stand so the backlight cable (#1) and eDP (#2) cable are facing you.



3. Disconnect the eDP cable from the connector on the LCD panel. Use your fingernail to flip the locking lever bail. Pull the cable out of the connector.



4. Locate the eDP substitution cable.



5. Either end of the eDP substitution cable can connect to the logic board; the other end connects to the display.

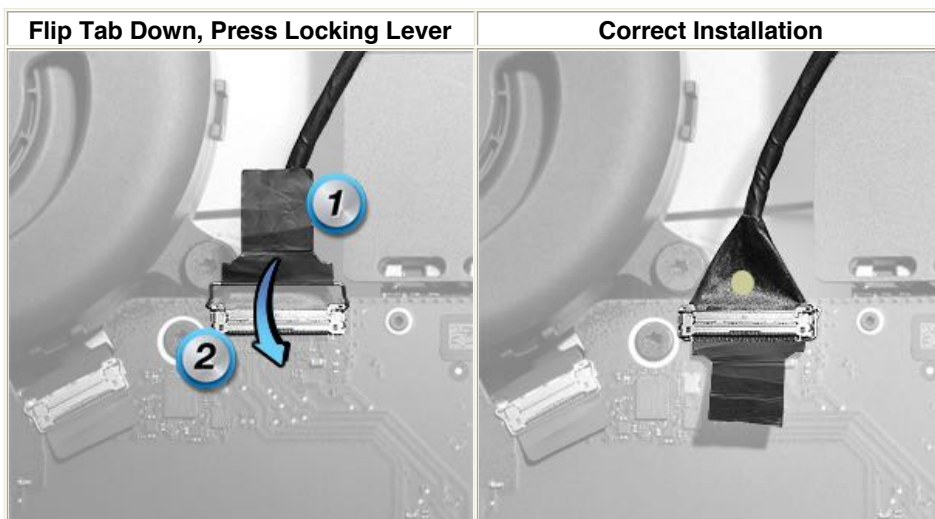
Important: Each end of the eDP substitution cable has a gold dot to indicate the cable orientation. Orient the cable with the gold dot side up when connecting the eDP substitution cable to the logic board and to the connector on the LCD panel. Connecting the cable upside down (with the brass connector facing you) will damage the logic board and/or the LCD panel.

Note: With proper care, cables will last for approximately 50 insertions. After 50 insertions, cable degradation may occur and Apple recommends ordering a new Display Extension/Substitution Cable Kit (refer to the Tools section above).

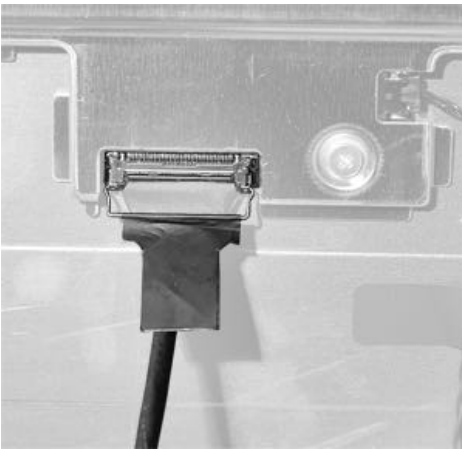


6. With the iMac unplugged, connect one end of the eDP substitution cable to the connector on the logic board. The cable should be aligned straight on with the connector and never inserted at an angle. The eDP substitution cable is shown properly connected to the logic board. **Important:** Ensure that the black tab is attached to the locking lever on the eDP cable. Attaching the locking lever without the black tab may cause damage to the logic board and/or the LCD panel.

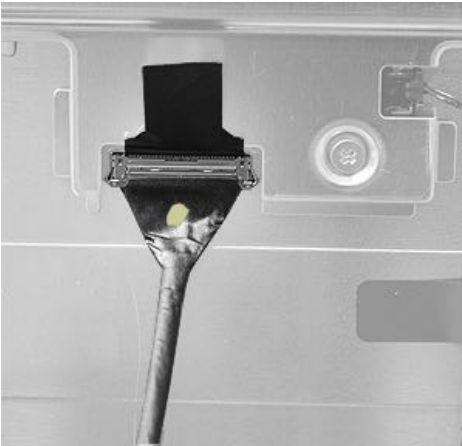
- Verify that each end of the cable has the gold dot side up.
- Check that the connector is fully seated.
- Flip the black tab down (#1).
- Press the locking lever (#2) to secure the cable to the logic board.



7. Connect the other end of the eDP substitution cable to the eDP connector on the back of the LCD panel.



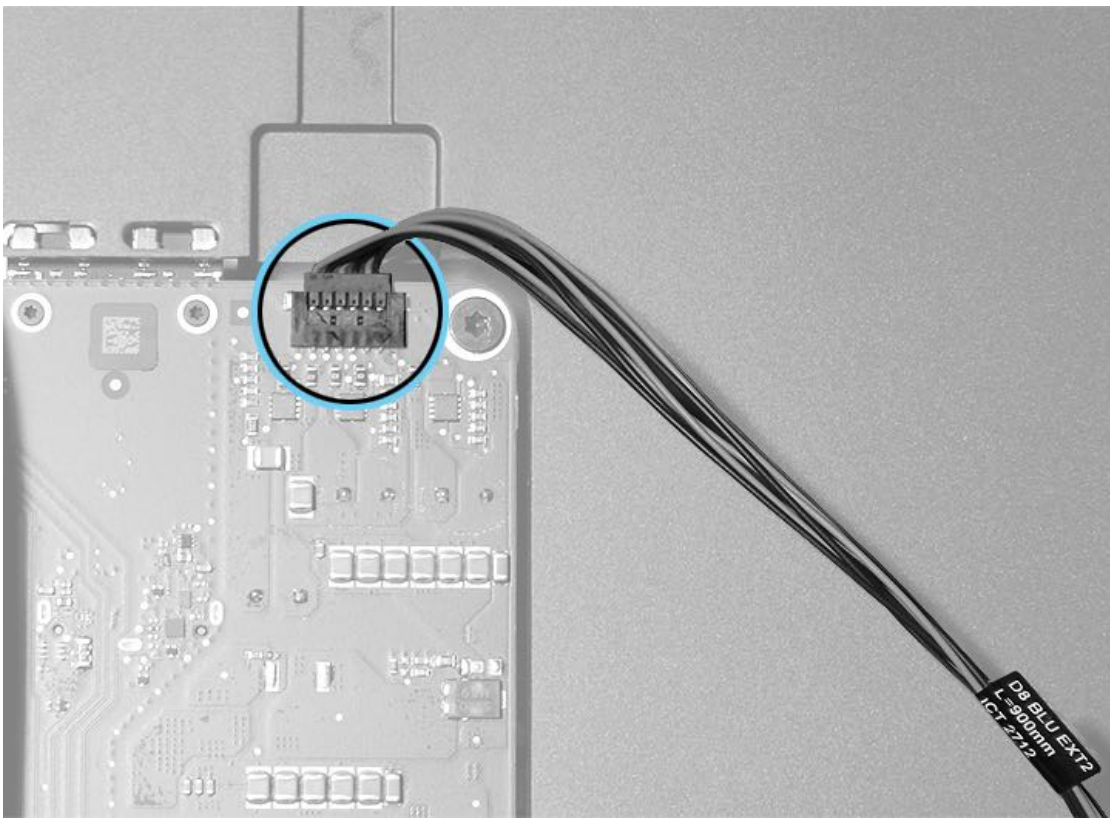
8. Flip the black tab up and press the locking lever bar to secure the cable to the connector on the panel.



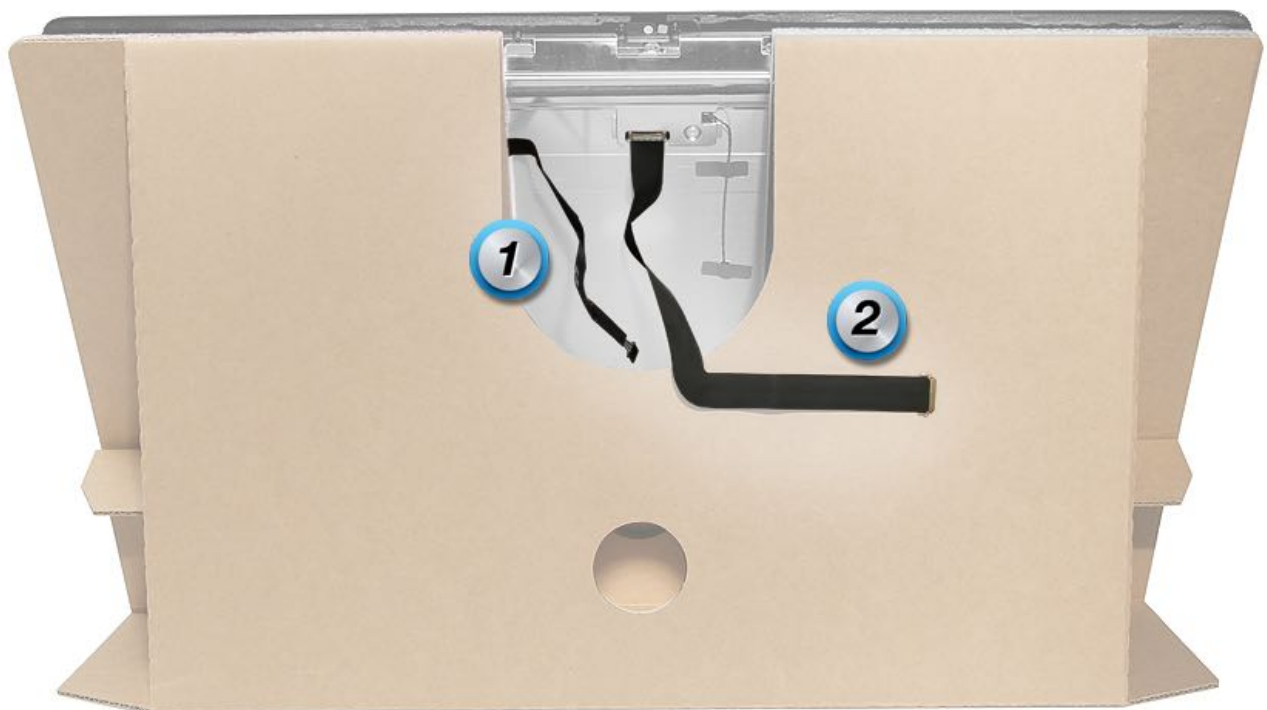
9. Locate the backlight extension cable (BLC).



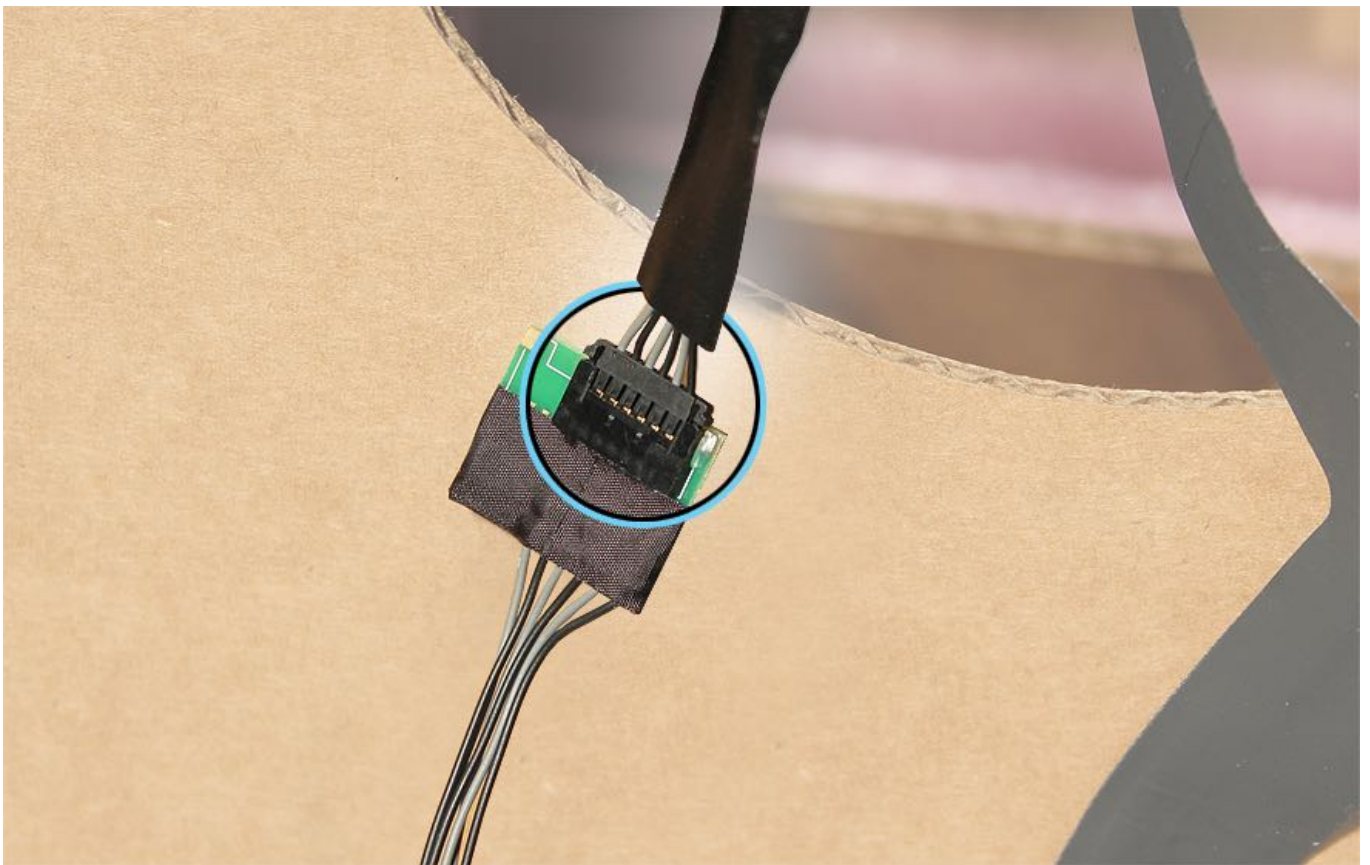
10. With the iMac unplugged, connect the backlight extension cable to the backlight connector on the logic board.



11. Connect the other end of the backlight extension cable to the dangling end of the LCD backlight cable (#1).

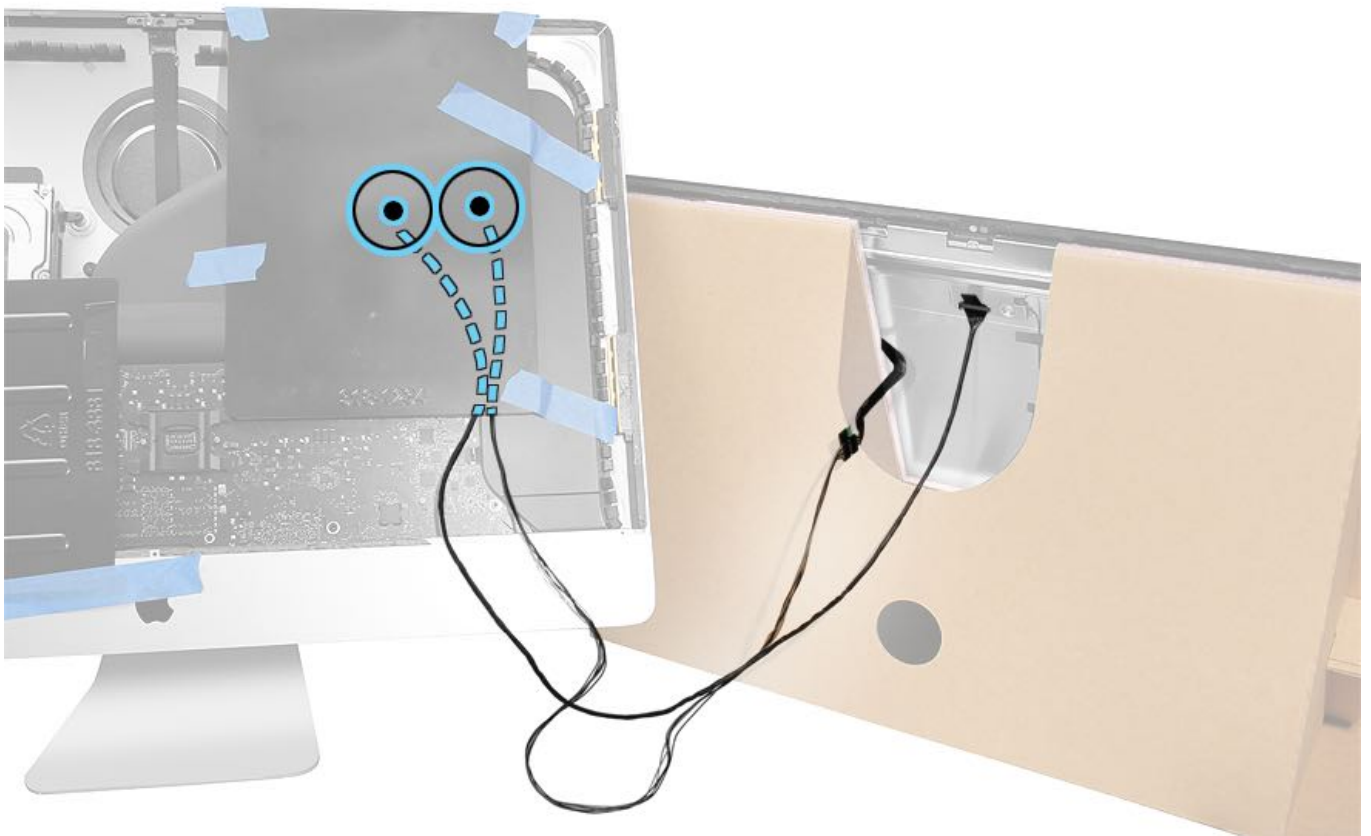


12. Securely mate the backlight extension cable with the panel's backlight cable connector.



13. Locate the two power supply covers. With the iMac unplugged, position one horizontally over the power supply and one vertically over the logic board and cables. Tape the power supply covers securely to the rear housing. The image below shows the proper cable setup for the eDP substitution cable and backlight extension cable.

14. Attach the power cord to the iMac and start up the system to verify eDP cable functionality.

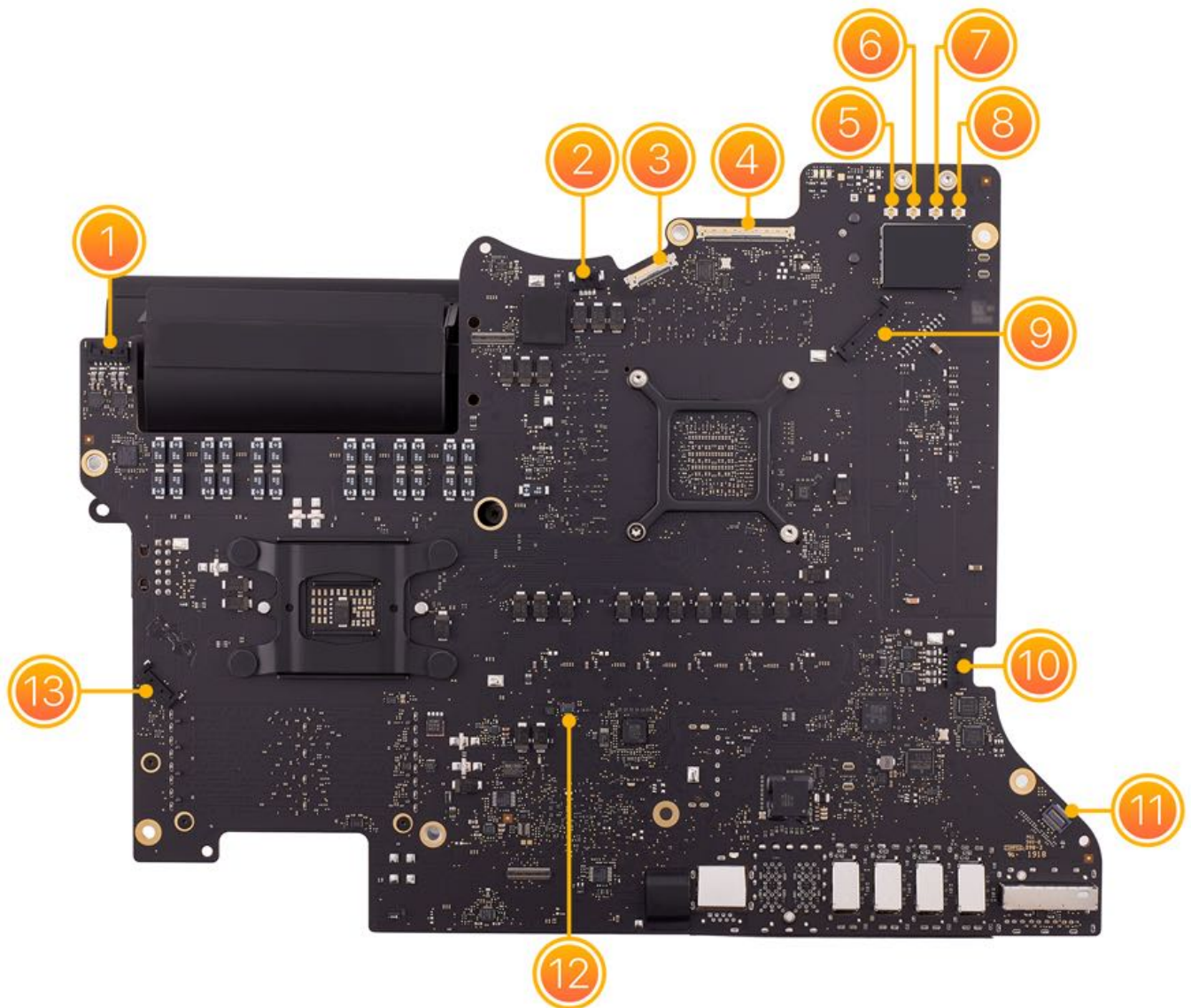


iMac (Retina 5K, 27-inch, 2019) Functional Overview

Functional Overview for iMac (Retina 5K, 27-inch, 2019)

Front of Logic Board

Refer to this diagram for symptoms related to connectors on the front of the logic board.

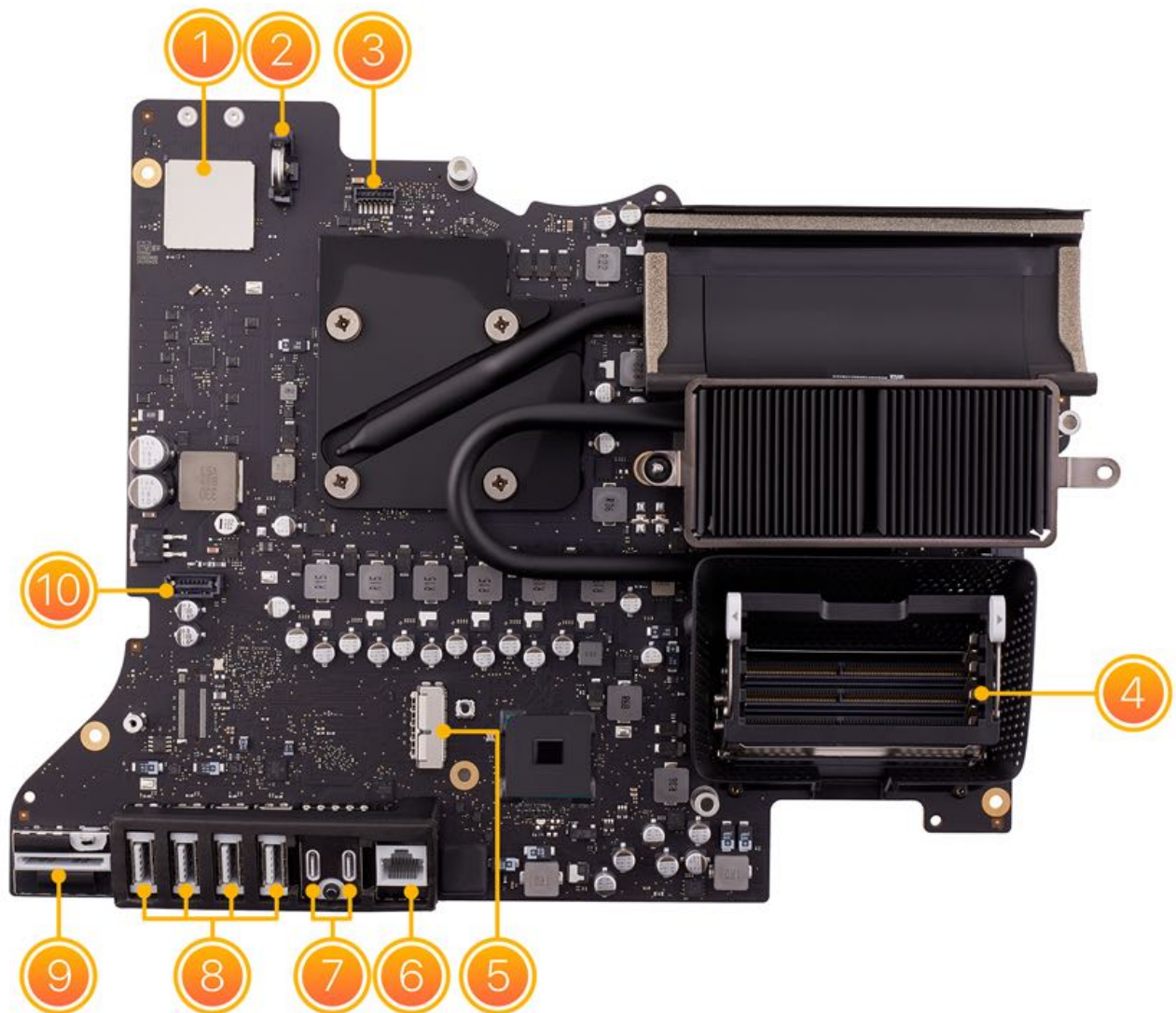


1. **Left speaker**
 - No sound from left speaker
 - Distorted sound from left speaker
2. **Fan**
 - System shuts down if fan is disconnected or blocked
 - System freezes or kernel panics
 - Noisy fan perception
3. **Camera, camera LED, and ambient light sensor (ALS)**
 - No camera function
 - No LED when camera is on
4. **Embedded DisplayPort (eDP) Video**
 - Poor or no video on internal display
5. **Rear Housing Wi-Fi antenna**
6. **Bluetooth antenna**
7. **Middle Wi-Fi antenna**
8. **Lower Wi-Fi antenna**
 - Weak signal strength over Wi-Fi or Bluetooth
 - Cannot connect to Wi-Fi networks or Bluetooth peripherals
 - Slow Wi-Fi or Bluetooth connection speed
9. **Display power (backlight control)**
 - No LED backlight on internal display
 - Open backlight fuse F8100 on logic board

10. **Right speaker**
 - No sound from right speaker
 - Distorted sound from right speaker
11. **Audio input/output**
 - No external analog audio input
 - No external analog audio output
 - No headset controls or mic input
12. **Microphone**
 - No input or distorted internal microphone input (with Internal Microphone selected in Sound Input Preferences)
13. **Power on signal and power supply temperature sensor**
 - No power
 - Intermittent shutdown (if cable is pinched or damaged)
 - Fan runs at full speed

Back of Logic Board

Refer to this diagram for symptoms related to the connectors on the back of the logic board.



1. **Integrated wireless card**
 - Cannot enable Wi-Fi and/or Bluetooth
 - Wi-Fi is not seen in System Info > Network > Wi-Fi
 - Bluetooth is not seen in System Info > USB
2. **Backup battery**
 - No power
 - No video
 - Beep tones on startup
3. **Hard drive power**
 - No SATA hard drive seen on SATA bus
 - No boot from hard drive or Fusion drive
4. **Memory**
 - No boot

- Beep tones on startup
- Freezes or kernel panics
- 5. **Flash storage**
 - No flash storage seen in System Info
- 6. **Ethernet RJ-45**
 - No wired Ethernet connectivity
 - Wired Ethernet data transfer issues
- 7. **USB-C ports (2)**
 - USB connectivity issues
 - USB power issues
 - No video to external display
 - No audio to external display speakers
 - Thunderbolt device not found
 - Thunderbolt controller not recognized
 - Thunderbolt driver issue
 - Thunderbolt power issues
- 8. **USB 3 ports (4)**
 - USB connectivity issues
 - Data transfer issues
- 9. **SD Card**
 - No SD card seen in System Info
 - Data transfer issues
- 10. **Hard drive data**
 - No SATA hard drive seen in System Info
 - No boot from hard drive

Bluetooth Device Connection Issues

Unlikely causes:

Battery, camera/microphone/ALS cable, fan, DisplayPort cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, flash storage card, stand

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Bluetooth cannot be enabledBluetooth is not detected or available in System InformationBluetooth can be turned on, but the computer is unable to pair with a known-good Bluetooth deviceIntermittent loss of communication with paired Bluetooth deviceData transfer over Bluetooth times out or is too slow <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">In System Preferences > Bluetooth, check that Bluetooth is on.Attempt to pair the computer with a known-good Bluetooth keyboard, mouse, or trackpad.Reset the Bluetooth device or delete the pairing (if applicable).Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates.If the customer is using a USB 3 device, review HT201163: Using USB devices with your Mac to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.If the user's computer pairs Bluetooth normally at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to HT201542: Resolve Wi-Fi and Bluetooth issues caused by wireless interference.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. <p>Warning: Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">TP833: iMac and Displays: Power Supply Cover InstructionsTP820: iMac (27-inch): SafetyTP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Com
1.	<p>Run Mac Resource Inspector (MRI) or check System Information to verify that the wireless module is recognized.</p> <p>System Information:</p> <ul style="list-style-type: none"> Hardware > Bluetooth <p>Is Bluetooth service detected in MRI or System Information?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M36	MLE
2.	<p>Open System Preferences > Bluetooth. Remove all paired devices. Pair the computer with a known-good Bluetooth device.</p> <p>Does the computer pair with a known-good Bluetooth device?</p>	Yes	Go to the “External Apple Bluetooth Peripherals” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Connect to a known-good Bluetooth device. Compare Bluetooth performance and reliability to a known-good computer of similar type and Bluetooth specification.</p> <p>Is the pairing issue resolved and is Bluetooth performance as expected?</p>	Yes	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Com
4.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
	Remove display panel.				
	Locate the Bluetooth antenna, and inspect antenna's cable and connector for any damage.				
	Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.	No	Replace Bluetooth antenna. Verify issue resolved.	X03	OTH ELE
	Are antenna cable and connector in good condition?				

	Check	Result	Action	Code	Com
5.	Locate Bluetooth antenna port on logic board (second connector from left), and verify it is not damaged, loosened, or unsoldered.	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
	<p>Note: Be sure to follow all service guide procedures and use the appropriate antenna removal tool and wireless card support tool when working with antenna cables. Failure to do so may result in logic board damage.</p> <p>Disconnect the Bluetooth antenna cable from the logic board.</p> <p>Reseat antenna connector to logic board. Make sure connection is secure and correctly aligned.</p>	No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M36	MLE
Is Bluetooth antenna connector port in good condition and securely seated?					
6.	Connect an external display and try to pair with a known-good Bluetooth device.	Yes	Issue resolved by reseating Bluetooth antenna. Verify resolution.	\${nodeText.yesSymptomCode}	
	Did computer pair successfully with known-good Bluetooth device?	No	Go to step 7.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Com
7.	<p>The Bluetooth antenna is located on upper edge of the enclosure and is available as a standalone part.</p> <p>Do you have immediate access to a known-good Bluetooth antenna?</p>	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
		No	Replace Bluetooth antenna. Verify issue resolved.	X03	OTH ELE
8.	<p>Substitute known-good Bluetooth antenna. Connect an external display and try to pair with a known-good Bluetooth device.</p> <p>Did computer pair successfully with known-good Bluetooth device?</p>	Yes	Replace Bluetooth antenna. Verify issue resolved.	X03	OTH ELE
		No	<p>Reinstall user's Bluetooth antenna.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M36	MLE
9.	<p>Pair with a known-good Bluetooth device and verify that the connection is sustained for several minutes.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Ethernet Issues

Unlikely causes:

AirPort/Bluetooth antenna(s), battery, camera, camera/microphone/ALS cable or camera cable, CPU fan, DisplayPort cable, hard disk drive (HDD), hard drive data or power or combo cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, solid state drive (SSD)/flash storage card, stand, wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• No Ethernet device present.• Unable to access Ethernet network resources.• Ethernet device shows no connection.• Ethernet device unable to get an IP address.• Slow Ethernet network performance. <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Verify the network setup by accessing it directly via a known-good computer's Ethernet port.2. Launch System Information. Verify that the computer's Ethernet port appears in the Network devices tree.3. Test with known-good network hardware and an Ethernet cable (Cat-5 or better is recommended for 100+ Mbps connections).4. Using known-good network hardware and cable, start up from a known-good, up-to-date macOS volume. Go to Network Utility > Info and verify that Link Status is "Active."5. Check network settings. If a known-good DHCP server is available, set System Preferences > Network > Ethernet to Using DHCP. Verify the IP address. (If it begins with 169.x.x.x, the system was unable to get a valid IP address.)6. When started up from user's OS, revert to default network settings by creating a new location in System Preferences > Network.7. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates.8. Run AST 1 or AST 2 Mac Resource Inspector (MRI) and check results to verify that Ethernet hardware is detected.9. If AST 1 or AST 2 is not available, use System Information to verify that Ethernet hardware is recognized. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none">• TP1620: iMac Pro (2017): Power Supply Cover Instructions• TP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Inspect the Ethernet port for dust, debris, damage, or bent pins. Use compressed air to remove debris. Plug in a known-good Ethernet cable and make sure all pins make physical contact with connector.</p> <p>Are any Ethernet port pins damaged or insufficiently contacting the known-good Ethernet connector?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 4.	\$(nodeText.noSymptomCode)	
2.	<p>Inspect logic board, Ethernet port, and enclosure for dents, scratches, or other indications of impact or abuse.</p> <p>Does accidental damage appear to be cause of issue?</p>	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M10	MLB
3.	<p>Inform user that computer failures due to accidental damage are not covered under any Apple warranty, including AppleCare. If applicable, discuss out-of-warranty repair options.</p> <p>Does user want to proceed with out-of-warranty repair?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M10	MLB
		No	<p>Issue resolved. Return computer to user using correct positioning.</p>	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
4.	<p>Ensure that the user's computer is connected to the Internet using a known-good Ethernet cable, and that Wi-Fi is turned off so that all network traffic goes through built-in Ethernet.</p> <p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p>	Yes	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	<p>\$(nodeText.yesSymptomCode)</p>	
	<p>Start up the computer to a known-good external macOS startup volume.</p> <p>Open Safari and attempt to access a known-good external web page such as www.apple.com to verify Ethernet connectivity. Look for the web page to load, or for a timeout indicating that the page did not load.</p> <p>Are Ethernet network resources accessible starting from a known-good macOS?</p>	No	Go to step 5.	<p>\$(nodeText.noSymptomCode)</p>	
5.	<p>Restart the user's computer to the built-in macOS boot volume.</p> <p>In System Preferences > Network > Ethernet, verify that the link status is Connected (green dot) and that a valid IP address is listed. Connect the computer to an Ethernet network with a known-good DHCP server. Make sure static DHCP maps or filtering are not preventing address allocation.</p> <p>Note: DHCP allocation may not be instantaneous, depending on network. Retest.</p> <p>Is Ethernet link status active?</p>	Yes	Go to step 6.	<p>\$(nodeText.yesSymptomCode)</p>	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	<p>M10</p>	MLB

	Check	Result	Action	Code	Commodity
6.	<p>Go to System Preferences > Network > Ethernet and obtain router IP address. Use Network Utility to ping router IP address. Use a simple hub/switch environment.</p> <p>Is Network Utility able to ping router IP address?</p>	Yes	No performance or connectivity issues detected. No repair necessary. The problem may be the network environment. Refer user to TS1317: Troubleshooting a cable modem, DSL, or LAN Internet connection .	\$(nodeText.yesSymptomCode)	
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	<p>Perform network testing from previous step, using same cable and network, but with a known-good computer.</p> <p>Is network performance of user's computer inferior to known-good computer?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M10	MLB
		No	No performance or connectivity issues detected. No repair necessary. The problem may be the network environment. Refer user to TS1317: Troubleshooting a cable modem, DSL, or LAN Internet connection .	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
8.	1. Connect Ethernet cable to a known-good network with a DHCP server. 2. In System Preferences > Network > Ethernet, verify link status is Connected (green dot). 3. Configure TCP/IP settings to Using DHCP and check that a valid IP address is obtained from server (not a self-assigned one starting with 169.x.x.x). 4. Launch web browser and verify that you can access websites and download files. Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Verify that the issue is resolved. Is issue resolved?	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M99	

Wi-Fi Connection Issues

Unlikely causes:

Battery, camera/microphone/ALS cable, DisplayPort cable, fan, flash storage card, display panel, left speaker, memory, power supply, right speaker, stand

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Wi-Fi service not available• Cannot turn Wi-Fi on• Wi-Fi can be turned on, but cannot connect to known-good Wi-Fi network• Intermittent loss of Wi-Fi communication• Poor Wi-Fi signal <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. In System Preferences > Network, check that Wi-Fi is on.2. Attempt to connect the computer to a known-good Wi-Fi network.3. Create a new network location in System Preferences.4. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Using Ethernet network interface, connect to the Internet, then check for and apply latest software and firmware updates.5. If the customer is using a USB 3 device, review HT201163: Using USB devices with your Mac to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.6. If the user's computer connects normally to Wi-Fi at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to HT201542: Resolve Wi-Fi and Bluetooth issues caused by wireless interference.7. Refer to HT202663: Check for Wi-Fi issues using your Mac to familiarize yourself with the macOS Wireless Diagnostic utility.8. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.9. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. <p>Warning: Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code
1.	<p>Check Mac Resource Inspector (MRI) test results or System Information > Network > Wi-Fi to verify that the wireless module is listed.</p> <p>Is Wi-Fi hardware detected?</p>	Yes	Go to step 2.	\$(nodeText.yesSym
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M35
2.	<p>Run Wireless Diagnostics by holding down the Option key, clicking the wireless icon in the menu bar, and then choosing Open Wireless Diagnostics.</p> <p>Wireless Diagnostics can also be found at: /System/Library/CoreServices/Applications/WirelessDiagnostics.app</p> <p>Does the computer complete Wireless Diagnostics with no issues?</p>	Yes	Go to step 3.	\$(nodeText.yesSym
		No	Go to step 4.	\$(nodeText.noSym
3.	<p>Connect to a known-good wireless network and open Wireless Diagnostics > Window > Performance. Review the quality graph to evaluate the signal quality of the wireless connection. Verify that the signal is good or excellent, and that the transmission rate (Tx Rate) is comparable to another known-good computer of similar type and Wi-Fi specification. Where available, switch between 2.4GHz and 5GHz networks to verify that the signal quality is comparable to a known-good computer.</p> <p>Using a network with a high transmission rate, download a large file from a known-good website or file server. Compare network performance to another known-good computer of similar type and Wi-Fi specification. Verify throughput using Activity Monitor > Network.</p> <p>Are the performance and throughput comparable between the user's computer and a known-good computer?</p>	Yes	Wi-Fi performance is within specification. Verify that the issue is resolved.	\$(nodeText.yesSym
		No	Go to step 4.	\$(nodeText.noSym
4.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Attempt to reproduce the Wi-Fi performance or connection issue.</p> <p>Does the issue persist with known-good macOS?</p>	Yes	Go to step 5.	\$(nodeText.yesSym
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSym

	Check	Result	Action	Code
5.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Go to step 7.	\$(nodeText.yesSym
	Remove display panel.	No	Go to step 6.	\$(nodeText.noSym
	Locate the three Wi-Fi antennas and inspect each antenna's cable and connector for any damage.			
	Are Wi-Fi antenna cables and connectors in good condition?			
6.	Verify whether affected Wi-Fi antenna is available separately as a service part. Is Wi-Fi antenna available as service part?	Yes	Replace affected Wi-Fi antenna. Verify issue resolved.	X03
		No	<p>ESCALATION REQUIRED.</p> <p>The antenna is part of the rear housing. Replace the rear housing. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	X99

	Check	Result	Action	Code
7.	<p>Locate Wi-Fi antenna connector ports on logic board (left connector and right two connectors) and verify that they are not damaged, loosened, or unsoldered.</p> <p>Note: Be sure to follow all service guide procedures and use the appropriate antenna removal tool and wireless card support tool when working with antenna cables. Failure to do so may result in logic board damage.</p> <p>Disconnect the Wi-Fi antenna cables from the logic board.</p> <p>Reseat antenna connectors to logic board. Make sure connections are secure and correctly aligned.</p>	Yes	Go to step 8.	\$(nodeText.yesSym
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24
8.	Are Wi-Fi antenna connector ports in good condition and securely seated?	Yes	Wi-Fi performance is within specification. Verify issue resolved.	\$(nodeText.yesSym
	<p>Connect external display and retest. Connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Is the issue resolved?</p>	No	Go to step 9.	\$(nodeText.noSym

	Check	Result	Action	Code
9.	<p>To troubleshoot this issue completely, a set of known-good Wi-Fi antennas is required.</p> <p>Note: Some Wi-Fi antennas are part of the rear housing and are not separately replaceable.</p> <p>Do you have immediate access to a set of known-good Wi-Fi antennas?</p>	Yes	Go to step 10.	\$(nodeText.yesSym
		No	Go to step 12.	\$(nodeText.noSym
10.	<p>Substitute known-good Wi-Fi antenna.</p> <p>Connect external display and retest. Connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Repeat with other antennas.</p> <p>Is the issue resolved?</p>	Yes	Go to step 11.	\$(nodeText.yesSym
		No	Go to step 12.	\$(nodeText.noSym
11.	<p>Verify whether affected Wi-Fi antenna is available separately as a service part.</p> <p>Is Wi-Fi antenna available as service part?</p>	Yes	Replace affected Wi-Fi antenna. Verify issue resolved.	X03
		No	<p>ESCALATION REQUIRED.</p> <p>The antenna is part of the rear housing. Replace the rear housing. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	X99
12.	<p>Reinstall the user's Wi-Fi antenna if it was removed during troubleshooting.</p> <p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> No Wi-Fi signal. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M40
		No	Go to step 13.	\$(nodeText.noSym

	Check	Result	Action	Code
13.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> Cannot connect to a known-good Wi-Fi network. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M41
		No	Go to step 14.	\$(nodeText.noSym
14.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> Onboard Wi-Fi Performance issue. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M42
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99
15.	<p>Connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\$(nodeText.yesSym
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99

Backlight Issues or No Backlight

Unlikely causes:

AirPort/Bluetooth card, AirPort antenna(s), battery, camera, camera/microphone/ALS cable or camera cable, CPU fan, hard disk drive (HDD), HDD data or power or combo cable, left speaker, memory, power supply, rear enclosure, right speaker, solid-state drive (SSD)/flash storage card, stand

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Display not illuminated• Flickering, unstable, or non-uniform backlight• Poor backlight at some or all settings• Display backlight fails after warmup• Display backlight fails at certain brightness settings• Unit appears to turn on and operate, but no image is seen on the display <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates.2. Cover ambient light sensor to mimic a dark room and adjust brightness to maximum setting using F2 key on wired keyboard.3. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.4. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.5. Put the computer to sleep by pressing Control-Shift-Eject. Wake it by pressing any key. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a compatible external display. Check to see whether the external display mirrors the backlight issue or shows any video at all. Does external display show a video signal of any kind?	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to “Power But No Video” troubleshooting flow.	\$(nodeText.noSymptomCode)	
2.	Run AST or AST 2 Mac Resource Inspector diagnostic suite (MRI). Review MRI results or System Information > Graphics/Displays. Look for information indicating internal display presence in results. Does MRI or System Information detect the display?	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	Go to “Power But No Video” troubleshooting flow.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
3.	Shine bright (low-heat) flashlight onto front of display panel. With computer turned on, verify whether a faint image is visible. Does display show a video signal despite not being backlit?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to “Power But No Video” troubleshooting flow.	\$(nodeText.noSymptomCode)	
4.	Important: Ensure that user’s computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components. Inspect display power cable and its connectors between logic board and display panel. Is the cable damaged?	Yes	Replace the display panel, which includes the display power cable. Verify issue resolved.	L09	LCD
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
5.	Reseat display power cable between logic board and display panel. Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer. WARNING: Be extremely careful when working inside the computer when power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in. For additional safety information and tips, refer to: <ul style="list-style-type: none">• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety Is normal video restored?	Yes	Issue resolved by reseating display power cable. Verify issue resolution.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
6.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Inspect DisplayPort cable for misrouting. Disconnect DisplayPort cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is DisplayPort cable or its connector damaged?</p>	Yes	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	<p>Keep DisplayPort cable disconnected from logic board. Inspect DisplayPort connector on the logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	Replace logic board. Verify issue resolved.	M24	MLB
		No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	<p>Test the logic board display backlight fuse with a multimeter. For information about using a multimeter, see HT3250: Using a digital multimeter.</p> <p>Locate fuse F8100 on the logic board. Be careful not to scratch or knock nearby components off the logic board when using the multimeter probes.</p> <p>Set the multimeter to measure ohms (Ω). Place the multimeter probes on each side of the fuse that is soldered to the logic board. The multimeter should measure between zero and one ohm.</p> <p>Refer to the service guide Functional Overview for information about locating fuse F8100.</p> <p>Does the multimeter show a reading greater than 1 Ω?</p>	Yes	Replace logic board. Verify issue resolved.	M25	MLB
		No	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	Reseat the DisplayPort cable between display panel and logic board. WARNING: Be extremely careful when working inside the computer when power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Is normal video restored?	Yes	Issue resolved by reseating DisplayPort cable. Verify issue resolution.	\$(nodeText.yesSymptomCode)	
		No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	To troubleshoot this issue completely, a known-good DisplayPort cable is required. The iMac Display Extension Cable Kit contains an embedded DisplayPort (eDP) substitution cable that can be used for testing. Refer to TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit or TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit for information about how to use extension cables. Do you have immediate access to a known-good DisplayPort cable?	Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
		No	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
11.	Important: Ensure that user's computer is shut down, then remove the power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components. Substitute a known-good DisplayPort cable or use the DisplayPort substitution cable found in the extension cable kit in place of suspect DisplayPort cable. Is normal video restored?	Yes	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
		No	Go to step 12.	\$(nodeText.noSymptomCode)	
12.	To troubleshoot this issue completely, a known-good display panel is required. Do you have immediate access to a known-good display panel?	Yes	Go to step 13.	\$(nodeText.yesSymptomCode)	
		No	Replace display panel. Verify issue resolved.	L09	LCD

	Check	Result	Action	Code	Commodity
13.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel.</p> <p>Is normal video restored?</p>	Yes	Replace display panel. Verify issue resolved.	L09	LCD
		No	Go to step 14.	\$(nodeText.noSymptomCode)	
14.	<p>To troubleshoot this issue completely, a known-good logic board is required.</p> <p>Do you have immediate access to a known-good logic board?</p>	Yes	Go to step 15.	\$(nodeText.yesSymptomCode)	
		No	Replace logic board. Verify issue resolved.	M25	MLB
15.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good logic board.</p> <p>Is normal video restored?</p>	Yes	Replace logic board. Verify issue resolved.	M25	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	
16.	<p>Restart the computer and verify that the display backlight is fully functional.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	\$(nodeText.noSymptomCode)	

Display Anomalies

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, flash storage card/solid-state drive (SSD), hard disk drive (HDD), hard drive data or power or combo cable, left speaker, power supply, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antenna(s), wireless card.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> • Distorted or blurred image • Pixel anomalies • Vertical/horizontal lines • Unstable flickering • Incorrect or missing colors • Nonuniform brightness at specific location • Vertical lines of nonuniform brightness repeating over the display • Image persistence or image sticking on screen • Light leakage around the display <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>References to the “Test Patterns Tool (TPT)” diagnostic in this procedure are intended for all iMac models introduced before 2014 that are supported by AST 1. For iMac models introduced in 2014 and later, use the “Display Anomalies” diagnostic that is supported by AST 2.</p> <p>Important: Follow instructions in TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays to identify conditions that affect warranty and service eligibility.</p> <p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"> 1. Compare an image on user’s display with the same image on an equivalent, known-good computer display. Small variations in display quality are normal and expected and may not indicate a service issue. 2. Clean the glass panel and check for dust or debris. 3. Check the brightness setting. 4. Verify that System Preferences > Universal Access > Seeing > Enhance Contrast is set to Normal. 5. Check System Preferences > Displays > Color for possible use of a custom display profile. Set profile to Color LCD. 6. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery. 7. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates, especially those that deal with display or graphic issues. 8. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac. 9. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP833: iMac and Displays: Power Supply Cover Instructions • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> • TP1620: iMac Pro (2017): Power Supply Cover Instructions • TP1637: iMac Pro (2017): Safety

	Check	Result	Action	Code	Commodity
1.	Identify the user's iMac model:	A	Go to step 2.	\$(nodeText.yesSymptomCode}	
	A. iMac Pro (2017) (includes T2 Security Chip) B. Other iMac models	B	Go to step 3.	\$(nodeText.noSymptomCode}	
	Which iMac model?				
2.	Follow steps in Restore Apple T2 firmware on iMac Pro to restore the T2 firmware on the user's computer.	Yes	Go to step 4.	\$(nodeText.yesSymptomCode}	
	Restart the computer and verify that it completely starts up to macOS. Retest for display issue. Does the issue persist after restoring T2 firmware?	No	The issue was resolved by restoring T2 firmware.	\$(nodeText.noSymptomCode}	
3.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 4.	\$(nodeText.yesSymptomCode}	
	Start up the computer to Internet Recovery. See HT201314: About macOS Recovery . Start up the computer to a known-good external macOS startup volume. Retest for display issue. Does the issue persist with a known-good macOS?	No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.noSymptomCode}	
4.	Use the Display Anomalies test suite in AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.	Yes	Go to "Unstable Flickering" troubleshooting flow.	\$(nodeText.yesSymptomCode}	
	Of the eight issues below, determine if "unstable flickering" best describes the primary symptom: <ul style="list-style-type: none"> • Unstable flickering • Distorted/blurred image • Vertical/horizontal lines • Pixel anomalies • Nonuniform brightness • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen Is unstable flickering the primary display issue?	No	Go to step 5.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display. Of the seven issues below, determine if "distorted/blurred image" or "unstable flickering" best describes the primary symptom: <ul style="list-style-type: none"> • Distorted/blurred image • Vertical/horizontal lines • Pixel anomalies • Nonuniform brightness • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen Is the primary issue distortion or blurring of the display image?	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	Go to step 18.	\$(nodeText.noSymptomCode)	
6.	Connect a compatible external display. Does image on external display appear distorted or blurred?	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Go to step 12.	\$(nodeText.noSymptomCode)	
7.	A distorted or blurred image may be related to a failing memory module. Watch closely during startup sequence for exact point at which issue starts to occur. Does issue occur BEFORE or AFTER Apple logo and spinning gear appears?	Before	Go to step 12.	\$(nodeText.yesSymptomCode)	
		After	Go to step 8	\$(nodeText.noSymptomCode)	
8.	Start the computer in Safe Mode. To start up into Safe Mode, follow steps listed in HT201262: Use safe mode to isolate issues with your Mac . Does issue still occur in Safe Mode?	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
		No	Go to step 9.	\$(nodeText.noSymptomCode)	
9.	Some models have RAM modules that are directly connected to the MLB. You are unable to remove the RAM on these models. Are you able to remove RAM modules?	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
		No	Go to step 12.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
10.	<p>Perform one-by-one replacement of user's memory modules with known-good memory, reassemble and retest. Depending on computer model, this may simply require removal of the rear door, or the removal of display panel and logic board to access the memory modules.</p> <p>Note: Be sure to always have at least the minimum amount of memory installed to support the computer and its OS. This may mean replacing a memory module with a known-good one of larger capacity for testing. For example, you may need to replace a 1 GB module with a known-good 2 GB module to support starting into macOS.</p> <p>Does issue occur only with specific memory modules?</p>	Yes	<p>Replace memory module.</p> <p>Note: Only replace defective memory module. There is no need to replace memory in pairs. Verify issue resolved.</p>	X06	MEMORY
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
11.	<p>Install a known-good memory module in one memory slot and retest. Repeat test with known-good memory for each additional memory slot, one at a time.</p> <p>Does issue occur only with a specific memory slot on logic board?</p>	Yes	<p>Reinstall user's memory.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M04	MLB
		No	Go to step 12.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
12.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove display panel and inspect DisplayPort cable for misrouting. Disconnect DisplayPort cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is DisplayPort cable or its connector damaged?</p>	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
		No	Go to step 15.	\${nodeText.noSymptomCode}	
13.	<p>To troubleshoot this issue completely, a known-good DisplayPort cable is required. The iMac Display Extension Cable Kit contains an embedded DisplayPort (eDP) substitution cable that can be used for testing.</p> <p>Refer to TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit or TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit for information about how to use extension cables.</p> <p>Do you have immediate access to a known-good DisplayPort cable?</p>	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
		No	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
14.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.</p> <p>Is normal video restored?</p>	Yes	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
		No	Go to step 15.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
15.	<p>Keep DisplayPort cable disconnected from logic board. Inspect DisplayPort connector on logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 16.	\$(nodeText.noSymptomCode}	
16.	<p>To completely troubleshoot this issue, a known-good display panel is required.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 17.	\$(nodeText.yesSymptomCode}	
		No	Replace display panel. Verify issue resolved.	L04	LCD
17.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel to test logic board video output.</p> <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety • TP1637: iMac Pro (2017): Safety <p>Is normal video restored?</p>	Yes	Replace display panel. Verify issue resolved.	L04	LCD
		No	<p>Reinstall user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M04	MLB

	Check	Result	Action	Code	Commodity
18.	<p>Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the six issues below, determine if "vertical/horizontal lines" best describes the primary symptom:</p> <ul style="list-style-type: none"> • Vertical/horizontal lines • Pixel anomalies • Nonuniform brightness • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen <p>Is the primary issue vertical or horizontal lines?</p>	Yes	Go to step 19.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 32.	`\${nodeText.noSymptomCode}`	
19.	<p>Connect an external compatible display.</p> <p>Are vertical or horizontal lines present on external display?</p>	Yes	Go to step 20.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 25.	`\${nodeText.noSymptomCode}`	
20.	<p>Vertical or horizontal lines may be related to a failing memory module. Watch closely during startup sequence for exact point at which issue starts to occur.</p> <p>Does issue occur BEFORE or AFTER Apple logo and spinning gear appears?</p>	Before	Go to step 25.	`\${nodeText.yesSymptomCode}`	
		After	Go to step 21.	`\${nodeText.noSymptomCode}`	
21.	<p>Start the computer in Safe Mode.</p> <p>To start up into Safe Mode, follow steps listed in HT201262: Use safe mode to isolate issues with your Mac.</p> <p>Does issue still occur in Safe Mode?</p>	Yes	Go to step 25.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 22.	`\${nodeText.noSymptomCode}`	
22.	<p>Some models have RAM modules that are directly connected to the MLB. You are unable to remove the RAM on these models.</p> <p>Are you able to remove RAM modules?</p>	Yes	Go to step 23.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 25.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
23.	<p>Perform one-by-one replacement of user's memory modules with known-good memory, reassemble and retest. Depending on computer model, this may simply require removal of the rear door, or the removal of display panel and logic board to access the memory modules.</p> <p>Note: Be sure to always have at least the minimum amount of memory installed to support computer and its OS. This may mean replacing a memory module with a known-good one of larger capacity for testing. For example, you may need to replace a 1GB module with a known-good 2GB module to support starting into macOS.</p> <p>Does issue occur only with specific memory modules?</p>	Yes	<p>Replace memory module.</p> <p>Note: Only replace defective memory module. There is no need to replace memory in pairs. Verify issue resolved.</p>	X06	MEMORY
		No	Go to step 24.	\$(nodeText.noSymptomCode)	
24.	<p>Install a known-good memory module in one memory slot and retest. Repeat test with known-good memory for each additional memory slot, one at a time.</p> <p>Does issue occur only with a specific memory slot on the logic board?</p>	Yes	<p>Reinstall user's memory.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M04	MLB
		No	Go to step 25.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
25.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove display panel and inspect DisplayPort cable for misrouting. Disconnect DisplayPort cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is DisplayPort cable or its connector damaged?</p>	Yes	Go to step 26.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 28.	`\${nodeText.noSymptomCode}`	
26.	<p>To troubleshoot this issue completely, a known-good DisplayPort cable is required. The iMac Display Extension Cable Kit contains an embedded DisplayPort (eDP) substitution cable that can be used for testing.</p> <p>Refer to TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit or TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit for information about how to use extension cables.</p> <p>Do you have immediate access to a known-good DisplayPort cable?</p>	Yes	Go to step 27.	`\${nodeText.yesSymptomCode}`	
		No	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
27.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.</p> <p>Is normal video restored?</p>	Yes	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
		No	Go to step 28.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
28.	<p>Keep DisplayPort cable disconnected from logic board. Inspect DisplayPort connector on logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 29.	\$(nodeText.noSymptomCode)	
29.	<p>To troubleshoot this issue completely, a known-good display panel is required.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 30.	\$(nodeText.yesSymptomCode)	
		No	Go to step 31.	\$(nodeText.noSymptomCode)	
30.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel to test logic board video output.</p> <p>Warning: Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety • TP1637: iMac Pro (2017): Safety <p>Is normal video restored?</p>	Yes	Go to step 31.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M04	MLB

	Check	Result	Action	Code	Commodity
31.	Examine image on display and determine whether lines are vertical or horizontal.	Vertical	Replace display panel. Verify issue resolved.	L27	LCD
	Are lines vertical or horizontal?	Horizontal	Replace display panel. Verify issue resolved.	L26	LCD
32.	Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.	Yes	Go to step 33.	`\${nodeText.yesSymptomCode}`	
	<p>Of the five issues below, determine if "pixel anomalies" best describes the primary symptom:</p> <ul style="list-style-type: none"> • Pixel anomalies • Nonuniform brightness • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen <p>Is the primary issue pixel anomalies?</p>	No	Go to step 37.	`\${nodeText.noSymptomCode}`	
33.	Thoroughly clean the display surface to remove any dust or debris.	Yes	The issue was resolved by cleaning the display. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Examine the cleaned display and try to reproduce the issue.	No	Go to step 34.	`\${nodeText.noSymptomCode}`	
34.	Was the issue resolved by cleaning the display?	No	Go to step 34.	`\${nodeText.noSymptomCode}`	
	<p>Shut down the computer and examine the area of the display that is affected by the symptom under a bright light source.</p> <p>Check that the area affected is not damaged by scratches, pits, or damage to the coating of the display.</p> <p>Refer to TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays for more information.</p> <p>Does the display surface appear damaged?</p>	Yes	Replace display panel. Verify issue resolved.	L19	LCD
		No	Go to step 35.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
35.	Run the Display Anomalies test suite in AST or AST 2.	Yes	Go to step 36	\${nodeText.yesSymptomCode}	
	If AST or AST 2 is not available, attempt to view the affected area against a number of solid-color backgrounds. Use System Preferences > Desktop & Screen Saver > Desktop, and select “Solid Colors” under “Apple” in the left-hand column.	No	Explain to user that the display is within specifications. Do not replace the display panel. Verify resolution.	\${nodeText.noSymptomCode}	
	Is the issue verified?				
36.	Refer to HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later to determine whether the number of defects in display exceeds specification.	Yes	Replace display panel. Verify issue resolved.	L20	LCD
	Does the number of pixel anomalies exceed the specified limit?	No	Explain to user that the display is within specifications. Do not replace the display panel. Verify resolution.	\${nodeText.noSymptomCode}	
37.	Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user’s display with the same image on an equivalent, known-good display.	Yes	Go to step 38.	\${nodeText.yesSymptomCode}	
	Of the four issues below, determine if “nonuniform brightness” best describes the primary symptom: <ul style="list-style-type: none"> • Nonuniform brightness • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen Is the primary issue nonuniform brightness?	No	Go to step 42.	\${nodeText.noSymptomCode}	
38.	Determine whether variation in uniformity appears excessive when compared to a known-good similar computer.	Yes	Go to step 39.	\${nodeText.yesSymptomCode}	
	Does nonuniform brightness exceed that of a known-good computer?	No	Display panel seems to be within specifications. Do not replace display panel. Verify resolution.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
39.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove display panel. Inspect for mechanical interference from screws or cables making contact with back of display panel. Reseat components and cables.</p> <p>Carefully clean all surfaces of any leftover tape or adhesive residue where panel contacts enclosure edges to ensure a good seal and a flat mating surface when display is resealed to these surfaces.</p> <p>Is normal video restored?</p>	Yes	Issue resolved by reseating internal components. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 40.	`\${nodeText.noSymptomCode}`	
40.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Inspect and reseat backlight cable.</p> <p>Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.</p> <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety • TP1637: iMac Pro (2017): Safety <p>Is normal video restored?</p>	Yes	Issue resolved by reseating backlight cables. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 41.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
41.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Reseat DisplayPort cable connector securely to logic board. Reconnect all internal cables and reinstall display panel. Retest.</p> <p>Is normal video restored?</p>	Yes	Issue resolved by reseating DisplayPort cable. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	Replace display panel. Verify issue resolved.	L21	LCD
42.	<p>Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the three issues below, determine if "incorrect or missing colors" best describes the primary symptom:</p> <ul style="list-style-type: none"> • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen <p>Is the primary issue incorrect or missing colors?</p>	Yes	Go to step 43.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 51.	`\${nodeText.noSymptomCode}`	
43.	<p>Verify that display is listed in System Information > Hardware > Graphics/Displays > Video Card. This ensures that color profile can be matched with display panel.</p> <p>Is display hardware detected?</p>	Yes	Go to step 44.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 45.	`\${nodeText.noSymptomCode}`	
44.	<p>Go to System Preferences > Displays > Color to make sure "iMac" is selected under Display profile. Inspect display again for incorrect or missing colors.</p> <p>Are colors still incorrect or missing when display profile is set to "iMac"?</p>	Yes	Go to step 45.	`\${nodeText.yesSymptomCode}`	
		No	Issue resolved by setting a valid display profile. User may have created an off-color calibration setting. Verify resolution.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
45.	Run Mac Resource Inspector (MRI) suite from AST or AST 2 to check if the display is fully recognized by the computer.	Yes	Go to step 47.	`\${nodeText.yesSymptomCode}`	
	If MRI is not available, go to System Information > Graphics/Displays to verify that Color LCD is recognized.	No	Go to step 46.	`\${nodeText.noSymptomCode}`	
	Is display hardware detected in MRI?				
46.	Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.	Yes	Issue resolved by reseating DisplayPort cable. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Reseat DisplayPort cable connector securely to logic board and retest.				
	Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.				
46.	Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in.	No	Go to step 47.	`\${nodeText.noSymptomCode}`	
	For additional safety information and tips refer to:				
	<ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety • TP1637: iMac Pro (2017): Safety 				
	Is normal video restored?				
47.	Launch the Test Pattern Tool (TPT) in AST or the Display Anomalies test suite in AST 2 to display the Solid Gray Light display test pattern.	Yes	Go to step 49.	`\${nodeText.yesSymptomCode}`	
	Verify whether incorrect/missing color issue affects entire screen.	No	Go to step 48.	`\${nodeText.noSymptomCode}`	
	Is entire screen affected?				

	Check	Result	Action	Code	Commodity
48.	Put computer side-by-side with a known-good equivalent iMac display showing same Solid Gray Light image. Is issue noticeably worse on the user's display?	Yes	Go to step 49.	\$(nodeText.yesSymptomCode)	
		No	Small variations in color uniformity are normal and do not warrant replacement of display.	\$(nodeText.noSymptomCode)	
49.	Troubleshooting this issue completely requires a known-good display panel. Do you have immediate access to a known-good display panel?	Yes	Go to step 50.	\$(nodeText.yesSymptomCode)	
		No	Replace display panel. Verify issue resolved.	L02	LCD
50.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel to test logic board video output.</p> <p>Is normal video restored?</p>	Yes	Replace display panel. Verify issue resolved.	L02	LCD
		No	<p>Reinstall user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M04	MLB
51.	<p>Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the two issues below, determine if "light leakage around the display" best describes the primary symptom:</p> <ul style="list-style-type: none"> Light leakage around the display Image persistence or image sticking on screen <p>Is the primary issue light leakage around the display?</p>	Yes	Go to step 52.	\$(nodeText.yesSymptomCode)	
		No	Go to step 55.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
52.	Launch the Test Pattern Tool (TPT) in AST or the Display Anomalies test suite in AST 2 to display the All Black display test pattern.	Yes	Go to step 53.	\$(nodeText.yesSymptomCode)	
	<p>It is very important that you verify this issue using ONLY an all black display test pattern with no other images present such as icons, dock, and so on.</p> <p>Adjust display position and brightness to normal settings.</p> <p>Dim lights so you can more clearly see any light leakage around edges of the display panel.</p> <p>Is any noticeable light leakage present around edges of the display?</p>	No	Explain to user that display is within specifications. Do not replace display panel. Verify resolution.	\$(nodeText.noSymptomCode)	
53.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Carefully disconnect and remove display panel.</p> <p>Carefully clean all surfaces of any leftover tape or adhesive residue where panel contacts enclosure edges to ensure a good seal and a flat mating surface when display is reseated to these surfaces.</p>	Yes	Replace chin strap. Reinstall user's display panel. Verify issue resolved.	X13	PIECE PART
	<p>Remove and closely inspect chin strap for any damage, bowing, or bending.</p> <p>Verify that all cushioned pads are securely installed on each end of the chin strap and are not damaged, torn, out of place, or missing. These pads are part of the chin strap.</p> <p>Does chin strap appear damaged, bent, or bowed?</p>	No	Go to step 54.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
54.	Recheck that previous disassembly was performed properly using proper tools and techniques and not by simply pulling display off. Incorrect removal technique can damage or bow chin strap, causing light leakage in lower display area.	Yes	Replace display panel. Verify issue resolved.	L288	LCD
	<p>Reinstall chin strap, being very careful to not damage, bow, or otherwise bend chin strap during installation.</p> <p>Reapply new foam tape gaskets for all four display sides, being very careful to apply the tape smoothly around entire edge.</p> <p>Reinstall display panel, being careful when seating edges of display against foam-backed tape around edges to ensure a smooth, complete seal around entire perimeter.</p> <p>Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.</p> <p>Retest using the Test Pattern Tool (TPT) in AST or the Display Anomalies test suite in AST 2 to display the All Black display test pattern.</p> <p>Is any noticeable light leakage still present around edges of display?</p>	No	Issue resolved by reseating display and chin strap. Verify issue resolution.	\$(nodeText.noSymptomCode)	
55.	A display might show a temporary faint remnant of a previous image even after a new image replaces it. Follow instructions using procedure listed for this computer in TP949: Image Persistence Test to determine if display fails or passes the Image Persistence Test.	Yes	Replace display panel. Verify issue resolved.	L25	LCD
	Does the display fail the Image Persistence Test?	No	The display is within specification. Do not replace display panel.	\$(nodeText.noSymptomCode)	
56.	Verify that display issue or anomaly has been resolved.	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
	<p>Run AST or AST 2 Full System Diagnostic (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

Power But No Video

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, CPU fan, flash storage card/solid-state drive (SSD), hard disk drive (HDD), hard drive data or power or combo cable, left speaker, power supply, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Power available, but no video visible on display• Fan or hard drive spinning sounds are audible• Caps Lock key LED illuminates when pressed <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Adjust settings to increase screen brightness.2. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.3. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.4. Disconnect all peripherals.5. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.6. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac .	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Look and listen for any evidence that the computer is starting up. Be aware that some iMacs do not emit a startup sound.</p> <p>Is there any evidence that the computer is starting up?</p>	No	Go to step 2.	`\${nodeText.noSymptomCode}`	
2.	A memory error is indicated by a sequence of one or three beep tones. Refer to HT201702: About Mac Power On Self Test (POST) RAM error codes for more information.	Yes	Go to “Will Not Start Up” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
	<p>Check whether computer has a memory error (a series of beep tones during startup).</p> <p>Does computer make error beep tones at startup?</p>	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	<p>Determine whether issue is no backlight or no image:</p> <ul style="list-style-type: none"> Image with no backlight can be seen by shining a low-heat light source onto the built-in display during or after startup. No image can be identified by a blank display with or without backlight or a solid color on the built-in display. <p>Is the issue no backlight or no image?</p>	No Backlight	Go to “Backlight Issues or No Backlight” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No Image	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	Connect a known-good external display and press power button. Hold down Command-R during startup to restart from the recovery partition. Toggle video mirroring (Command-F1) to view main screen startup screen on external display. Verify that video is correct when viewed on external display.	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	Is correct image visible on external display?	No	Go to step 11.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding and allow the power supply and logic board to discharge.	Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
	<p>Use one of the methods below to determine whether the user's computer recognizes its built-in display panel.</p> <p>METHOD 1: Review MRI results or System Information > Graphics/Displays. Look for information indicating internal display presence in results.</p> <p>METHOD 2: Remove display panel.</p> <p>Connect AC power cord to computer and plug into mains. Locate diagnostic LEDs on logic board. Connect a known-good external display and press power button. During startup, computer should communicate with video controller and light diagnostic LED #4 to indicate an active display.</p> <p>Note: LED #4 may not light with display panel removed.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Is built-in display panel detected?</p>	No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	Inspect DisplayPort cable and connectors for damage. Also inspect connectors on display panel and logic board.	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
	Did you find any damaged components?	No	Go to step 8.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	<p>Damage to multiple parts requires an escalation to ACS for approval for repair.</p> <p>Is damage limited to DisplayPort cable only?</p>	Yes	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	
8.	<p>Test the logic board display power fuse with a multimeter. For information about using a multimeter, see HT3250: Using a digital multimeter.</p> <p>Locate fuse F4400 on the logic board. Be careful not to scratch or knock nearby components off the logic board when using the multimeter probes.</p> <p>Set the multimeter to measure ohms (Ω). Place the multimeter probes on each side of the fuse that is soldered to the logic board. The multimeter should measure between zero and one ohm.</p> <p>Refer to the service guide Functional Overview for information about locating fuse F4400.</p> <p>Does the multimeter show a reading greater than 1 Ω?</p>	Yes	Replace logic board. Verify issue resolved.	M03	MLB
		No	Go to step 9.	\${nodeText.noSymptomCode}	
9.	<p>To troubleshoot this issue completely, a known-good DisplayPort cable is required. The iMac Display Extension Cable Kit contains an embedded DisplayPort (eDP) substitution cable that can be used for testing.</p> <p>Refer to TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit or TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit for information about how to use extension cables.</p> <p>Do you have immediate access to a known-good DisplayPort cable?</p>	Yes	Go to step 10.	\${nodeText.yesSymptomCode}	
		No	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
10.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.</p> <p>If any known-good cables are still installed from previous steps, continue using known-good cables to help find faulty module.</p> <p>Does display present video with or without backlight?</p>	With Backlight	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
		No Backlight	Replace the display panel. Verify issue resolved.	L03	LCD
11.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding and allow the power supply and logic board to discharge.</p> <p>Remove display panel.</p> <p>Locate diagnostic LEDs on logic board. Connect AC power cord and press power button, diagnostic LEDs #1 and #2 should be on. This indicates power to computer.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Are diagnostic LEDs #1 and #2 on?</p>	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	Go to "No Power" troubleshooting flow.	`\${nodeText.noSymptomCode}`	
12.	<p>Disconnect DisplayPort cable from logic board. Connect a known-good external display and press power button. Hold down Command-R during startup to restart from recovery partition. Toggle video mirroring (Command-F1) to view main screen startup screen on external display. Verify that video is correct when viewed on external display.</p> <p>Is correct image visible on external display?</p>	Yes	Replace display panel. Verify issue resolved.	L03	LCD
		No	Replace logic board. Verify issue resolved.	M03	MLB

	Check	Result	Action	Code	Commodity
13.	Restart the computer and verify that the video is fully functional. Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Verify that the issue is resolved. Is the issue resolved?	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	\${nodeText.noSymptomCode}	

Unstable Flickering

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, hard disk drive (HDD), hard drive data or power or combo cable, left speaker, memory, power supply, rear enclosure, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Flickering video image• Flickering backlight• Dock or menu bar position not stable• Display intermittently flashes on and off• Unstable image <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">1. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.2. Check the brightness setting.3. Refer to HT201260: Find out which macOS your Mac is using to make sure the system build is correct for this computer model. Check for and apply the latest software and firmware updates, especially those that deal with display or graphic issues. Remember that some external Apple display adapters also contain firmware that may need updating. For more information, refer to HT201177: Get help with video issues on external displays connected to your Mac.4. Clean display and check for dust or debris.5. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.6. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none">• TP1620: iMac Pro (2017): Power Supply Cover Instructions• TP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Adjust built-in display brightness setting to low backlight level, just above off.	Backlight	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<p>Verify whether user issue is due to backlight flickering or to an unstable or flickering video image on display.</p> <p>You may need to shine a bright (low heat) flashlight onto front of display panel with computer turned ON to verify whether a faint video image is occasionally visible through the flickering.</p> <p>Note: If video is present but backlight never turns on, exit this procedure and go to the “Backlight Issues or No Backlight” troubleshooting flow instead. Use this procedure only for flickering backlight or video image.</p> <p>Which is flickering, backlight or video?</p>	Video	Go to step 8.	`\${nodeText.noSymptomCode}`	
2.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Inspect display power cable and its connectors between logic board and display panel.</p> <p>Is display power cable damaged?</p>	Yes	Replace display panel, which includes display power cable. Verify issue resolved.	L06	LCD
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
3.	Reseat display power cable between logic board and display panel. Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.	Yes	Issue resolved by reseating display power cable. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
	Warning: Be extremely careful when working inside the computer while power is connected and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.				
	For additional safety information and tips, refer to: <ul style="list-style-type: none"> TP820: iMac (27-inch): Safety TP914: iMac (21.5-inch): Safety TP1637: iMac Pro (2017): Safety Is normal video restored?	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	To troubleshoot this issue completely, a known-good display panel is required.	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	Do you have immediate access to a known-good display panel?	No	Replace display panel. Verify issue resolved.	L06	LCD
5.	Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.	Yes	Replace display panel. Verify issue resolved.	L06	LCD
	Substitute a known-good display panel.	No	Go to step 6.	`\${nodeText.noSymptomCode}`	
	Is normal video restored?				
6.	To troubleshoot this issue completely, a known-good power supply is required.	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
	Do you have immediate access to a known-good power supply?	No	Replace power supply. Verify issue resolved.	P99	POWER SUPPLY

	Check	Result	Action	Code	Commodity
7.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good power supply.</p> <p>Is normal video restored?</p>	Yes	Replace power supply. Verify issue resolved.	P99	POWER SUPPLY
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	
8.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel and inspect DisplayPort cable for misrouting. Disconnect DisplayPort cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is DisplayPort cable or its connector damaged?</p>	Yes	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
		No	Go to step 9.	\$(nodeText.noSymptomCode)	
9.	<p>Keep DisplayPort cable disconnected from logic board. Inspect DisplayPort connector on logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 10.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
10.	Reseat DisplayPort cable between LCD panel and logic board. Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.	Yes	Issue resolved by reseating DisplayPort cable. Verify issue resolution.	\$(nodeText.yesSymptomCode)	
	Warning: Be extremely careful when working inside the computer while power is connected and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.				
	For additional safety information and tips, refer to: <ul style="list-style-type: none"> TP820: iMac (27-inch): Safety TP914: iMac (21.5-inch): Safety TP1637: iMac Pro (2017): Safety 	No	Go to step 11.	\$(nodeText.noSymptomCode)	
	Is normal video restored?				
11.	To troubleshoot this issue completely, a known-good DisplayPort cable is required. The iMac Display Extension Cable Kit contains an embedded DisplayPort (eDP) substitution cable that can be used for testing.	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
	Refer to TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit or TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit for information about how to use extension cables. Do you have immediate access to a known-good DisplayPort cable?	No	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
12.	Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.	Yes	Replace DisplayPort cable. Verify issue resolved.	X03	INTERNAL CABLE
	Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.	No	Go to step 13.	\$(nodeText.noSymptomCode)	
	Is normal video restored?				

	Check	Result	Action	Code	Commodity
13.	To troubleshoot this issue completely, a known-good display panel is required. Do you have immediate access to a known-good display panel?	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
		No	Replace display panel. Verify issue resolved.	L06	LCD
14.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel.</p> <p>Is normal video restored?</p>	Yes	Replace display panel. Verify issue resolved.	L06	LCD
		No	<p>Reinstall user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M29	MLB
15.	<p>Confirm that the computer display flickering or unstable video issue is resolved.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

Audio Input Issues

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, DisplayPort cable, hard disk drive (HDD), hard drive data or power or combo cable, display panel, left speaker, memory, power supply, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Audio input port does not function, but audio output is functionalAudio input port produces distorted audioAudio input port cannot be selected <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Some iMac models do not support optical audio. Refer to Apple product specifications for more information.Verify that nothing is inserted into the audio input port on the user's computer. Use an otoscope to visually inspect the port.Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port (headphone jack) on the user's computer. Verify that the 3.5 mm stereo plug is seated fully in the port.Go to System Preferences > Sound, and verify the following:<ul style="list-style-type: none">Input tab:<ul style="list-style-type: none">External Microphone is available and selected for sound input."Input volume" is not set to zero.Output tab:<ul style="list-style-type: none">Internal Speaker is available and selected for sound output."Output volume" is not muted or set to zero.Go to System Preferences > Sound > Input tab, and verify that the "Input level" indicator moves when speaking into the EarPod's microphone.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the user's iMac model:	A	Go to step 2.	\$(nodeText.yesSymptomCode)	
	A. iMac Pro (2017) (includes T2 Security Chip) B. Other iMac models	B	Go to step 3.	\$(nodeText.noSymptomCode)	
	Which iMac model?				

	Check	Result	Action	Code	Commodity
2.	<p>Follow steps in Restore Apple T2 firmware on iMac Pro to restore the T2 firmware on the user's computer.</p> <p>Restart the computer and verify that it completely starts up to macOS.</p> <p>Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port (headphone jack) on the user's computer. Verify that the 3.5 mm stereo plug is seated fully in the port.</p> <p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Does the issue persist after restoring T2 firmware?</p>	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	The issue was resolved by restoring T2 firmware.	`\${nodeText.noSymptomCode}`	
3.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port (headphone jack) on the user's computer. Verify that the 3.5 mm stereo plug is seated fully in the port.</p> <p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Does the issue persist with a known-good macOS?</p>	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	Disconnect any connected headphones or external speakers. Check whether System Preferences > Sound > Input tab shows an “Internal microphone” source available and selected. Does System Preferences list “External microphone” instead?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
5.	Debris in, or damage to, the headphone jack can cause the computer to become stuck in External Microphone input mode. Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack. Use compressed air to clean and remove any debris. Is there any damage to the headphone jack?	Yes	ESCALATION REQUIRED. The headphone jack is part of the rear enclosure. Replace the rear enclosure. Verify issue resolved. Inform user that failures due to accidental damage are not covered by Apple’s one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty . Contact ACS for additional support regarding warranty coverage for this part.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	Run AST or AST 2 Audio Test suite to verify that built-in microphones detect expected audio test patterns produced from each speaker. Refer to TP587: Using Audio Test . Does the computer pass Audio test suite?	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	If the microphone tests failed, then return to the list of symptoms and select “Internal Microphone Issues” from the troubleshooting menu.	\$(nodeText.noSymptomCode)	
7.	Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port (headphone jack) on the user’s computer. Verify that the 3.5 mm stereo plug is seated fully in the port. Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone. Is the issue resolved?	Yes	Issue resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M09	MLB

	Check	Result	Action	Code	Commodity
8.	Verify that external audio input is available, selected, and functional, and that the “Input level” indicator moves when speaking into a connected microphone. Then record a sample audio file and play it back to verify that it is free of distortion.	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
	<p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Camera Issues

Unlikely causes:

Battery, CPU fan, DisplayPort cable, hard disk drive (HDD), hard drive data or power or combo cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, solid state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Camera not detected• No green LED for camera• Excessive blooming• Poor white balance• Poor focus• Green image• Image distortion <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Check HT201260: Find out which macOS your Mac is using to verify system build is correct for this computer model. Check for and apply the latest software and firmware updates.2. Verify camera lens and glass panel are clear of contaminants.3. Ask user about lighting conditions in working environment. Dim lighting causes poor image quality. Overly bright lighting can bounce off surfaces onto subject and make image foggy.4. Striped, textured, and mesh clothing can create moiré patterns in image.5. Reset SMC using procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.6. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.7. Disconnect all peripheral devices and restart computer. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Check Mac Resource Inspector (MRI) results to verify that the camera is detected.</p> <p>If AST 1 or AST 2 is not available, use System Information to verify that the FaceTime HD Camera is recognized.</p> <p>Depending on computer model, the camera will be listed in System Information > Hardware > USB or Camera Device Tree. Verify that "FaceTime HD Camera (Internal)" is listed.</p> <p>Does MRI or System Information detect the camera?</p>	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
		No	Go to step 3.	\${nodeText.noSymptomCode}	
2.	<p>Launch Photo Booth. Verify that the green LED next to the camera illuminates when an image is present in Photo Booth.</p> <p>Does the camera LED light up?</p>	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
		No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Attempt to reproduce the camera issue.</p> <p>Does the camera function properly in a known-good macOS?</p>	Yes	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
4.	<p>Verify that the camera image is clear and undistorted.</p> <p>Is the image clear?</p>	Yes	<p>The issue is resolved.</p> <p>Verify resolution.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
5.	<p>Check camera/microphone/ALS Cable or camera cable connection to camera and to logic board. Check cable connectors to camera and logic board for loose or broken wires or pins.</p> <p>Does camera cable show any signs of damage?</p>	Yes	<p>Replace camera/microphone/ALS Cable or camera cable (depending on model).</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 6.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
6.	Inspect camera/microphone/ALS Cable or camera cable connectors on logic board, looking for a missing connector, cracking housing, or bent or broken pins that may have lifted from logic board solder pads. Does logic board connector show any signs of damage?	Yes	Replace the logic board. Verify issue resolved.	M13	MLB
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	Reseat camera cable securely to logic board. Check System Information again. Does camera appear in System Information?	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
		No	Go to step 9.	\$(nodeText.noSymptomCode)	
8.	Launch Photo Booth. Verify that green LED next to camera lights up. Make sure image looks normal. Does camera LED light up and image appear normal?	Yes	Issue resolved by reseating the camera cable. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
9.	To troubleshoot this issue completely, a known-good camera/microphone/ALS Cable or camera cable (depending on model) is required. Do you have immediate access to a known-good camera cable?	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
		No	Replace camera/microphone/ALS Cable or camera cable (depending on model). Verify that the issue is resolved.	X03	INTERNAL CABLE
10.	Substitute a known-good camera/microphone/ALS Cable or camera cable (depending on model) and retest. Is camera working normally?	Yes	Replace camera/microphone/ALS Cable or camera cable (depending on model). Verify that the issue is resolved.	X03	INTERNAL CABLE
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
11.	To troubleshoot this issue completely, a known-good camera is required. Do you have immediate access to a known-good camera?	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
		No	Replace camera. Verify issue resolved.	X21	OTHER ELECTRIC
12.	Substitute a known-good camera and retest. Is camera working normally?	Yes	Replace camera. Verify issue resolved.	X21	OTHER ELECTRIC
		No	Go to step 13.	\$(nodeText.noSymptomCode)	
13.	To troubleshoot this issue completely, a known-good logic board is required. Do you have immediate access to a known-good logic board?	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
		No	Replace the logic board. Verify issue resolved.	M13	MLB

	Check	Result	Action	Code	Commodity
14.	Substitute a known-good logic board and retest. Is camera working normally?	Yes	Replace the logic board. Verify issue resolved.	M13	MLB
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M99	
15.	Confirm that the computer's FaceTime camera is recognized and functional. Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Verify that the issue is resolved. Is issue resolved?	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M99	

Distorted Audio from Internal Speakers

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, DisplayPort cable, flash storage card/solid-state drive (SSD), hard disk drive (HDD), hard drive data or power or combo cable, display panel, memory, power supply, stand, Wi-Fi/Bluetooth antennas, wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Sound is distorted, fuzzy, or crackly• Symptom only occurs with internal speakers• Symptom only occurs with external speakers or headphones <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Use controls to increase the sound volume to medium, halfway between minimum and maximum setting.2. In System Preferences > Sound > Output, verify “Internal Speaker” output is available and selected.3. Connect headphones or external speakers to the headphone jack. In System Preferences > Sound > Output, verify whether the Internal Speakers setting switches to Headphones, and whether audio can be played on headphones or external speakers.4. Disconnect any device connected to the headphone jack. In System Preferences > Sound > Output, check that the sound output device reverts to Internal Speakers and that the Balance slider is set halfway between left and right.5. If testing using iTunes, check that the equalizer is not turned on.6. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.7. Test the audio output using more than one application or website.8. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.9. Check for and apply the latest software and firmware updates. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none">• TP1620: iMac Pro (2017): Power Supply Cover Instructions• TP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the user's iMac model: A. iMac Pro (2017) (includes T2 Security Chip) B. Other iMac models Which iMac model?	A	Go to step 2.	\$(nodeText.yesSymptomCode}	
		B	Go to step 3.	\$(nodeText.noSymptomCode}	
2.	Follow steps in Restore Apple T2 firmware on iMac Pro to restore the T2 firmware on the user's computer. Restart the computer and verify that it completely starts up to macOS. Retest for speaker or headphone jack audio issue. Does the issue persist after restoring T2 firmware?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode}	
		No	The issue was resolved by restoring T2 firmware.	\$(nodeText.noSymptomCode}	
3.	Use one of the following two methods to start up the computer to a known-good macOS. Start up the computer to Internet Recovery. See HT201314: About macOS Recovery . Start up the computer to a known-good external macOS startup volume. Retest for speaker or headphone jack audio issue. Does the issue persist with a known-good macOS?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode}	
		No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.noSymptomCode}	
4.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Output tab and verify that Internal Speaker is available and selected for sound output. Does System Preferences list "Headphones" instead?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode}	
		No	Go to step 6.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	<p>Debris in, or damage to, the headphone jack can cause the computer to become stuck in Headphone or External Speaker mode.</p> <p>Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.</p> <p>Use compressed air to clean and remove any debris.</p> <p>Is there any damage to the headphone jack?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>The headphone jack is part of the rear enclosure. Replace the rear enclosure. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	<p>\$(nodeText.yesSymptomCode)</p>	
		No	Go to step 6	\$(nodeText.noSymptomCode)	
6.	<p>Run AST or AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to TP587: Using Audio Test.</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
	Does the computer pass AST 2 Audio Test suite?	No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel.</p> <p>Locate speaker connections on logic board. Disconnect and inspect both speaker cable connectors and corresponding connectors on logic board for damage.</p> <p>Reconnect the left and right speakers to the logic board, verifying that the connections are all seated properly.</p> <p>Did you find damage to speakers or logic board connector?</p>	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
		No	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
8.	Determine whether damage is on the logic board, speakers, or both.	Yes	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit. Verify that the issue is resolved.	X09	OTHER ELECTRIC
	Is the damage limited to speakers?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
9.	With speaker connectors reseated to logic board, verify you can hear audio through internal speakers.	Yes	The issue was resolved by reseating cables. Verify resolution.	\${nodeText.yesSymptomCode}	
	<p>In System Preferences > Sound > Output tab, adjust Balance slider to check left and right speaker channel separation.</p> <p>Play music with high and low tones to check bass and tweeter performance of left and right speakers.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Do internal speakers present full range of expected audio performance?</p>	No	Go to step 10.	\${nodeText.noSymptomCode}	
10.	Inspect and carefully clean affected speaker cone using a soft tissue to remove dust, debris, or foreign material such as metal fragments that easily adhere to the magnetic speaker. Reseat speaker connection and retest.	Yes	Issue resolved by cleaning the speaker membrane. Verify resolution.	\${nodeText.yesSymptomCode}	
	Is sound from affected speaker audible, clear, and free of distortion?	No	Go to step 11.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
11.	To continue troubleshooting this issue, a known-good left and right speaker set is required.	Yes	Go to step 12.	\${nodeText.yesSymptomCode}	
	<p>Internal speakers are specified to work as a matched pair and must be tested or replaced as matched pairs.</p> <p>Keep and identify your known-good speakers from one kit as a matched pair.</p> <p>Do you have immediate access to a known-good speaker set?</p>	No	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Verify that the issue is resolved.</p>	X09	OTHER ELECTRIC
12.	Substitute a known-good internal speaker set and verify you can hear audio through internal speakers.	Yes	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Verify that the issue is resolved.</p>	X09	OTHER ELECTRIC
	<p>Run AST or AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to TP587: Using Audio Test.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Does unit pass Audio Test?</p>	No	<p>Reinstall the user's speakers.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB
13.	Connect and disconnect headphones/external speakers. Verify that audio can be played through both external and internal speakers, and that sound is clear and free of distortion.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	<p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

External Apple Bluetooth Peripherals

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> • Apple Bluetooth wireless keyboard, mouse, or trackpad is not recognized by known-good computer • Apple Bluetooth wireless keyboard, mouse, or trackpad will not pair with known-good computer • Apple Bluetooth wireless keyboard, mouse, or trackpad intermittently loses its connection • Apple wireless keyboard has one or more of the following issues: <ul style="list-style-type: none"> ◦ No power ◦ Battery will not charge (for peripherals with embedded batteries) ◦ Swollen battery (for peripherals with embedded batteries) ◦ Battery runtime too short ◦ Will not turn off ◦ One or more keys do not work ◦ Keys seem to stick, do not respond properly, or respond slowly ◦ Wrong keyboard language ◦ Keys missing or falling off ◦ Paint wearing off of one or more keys ◦ Physical and/or cosmetic issues • Apple wireless mouse has one or more of the following issues: <ul style="list-style-type: none"> ◦ No power ◦ Battery will not charge (for peripherals with embedded batteries) ◦ Swollen battery (for peripherals with embedded batteries) ◦ Battery runtime too short ◦ Will not turn off ◦ No mouse response ◦ Mouse click not recognized ◦ Mouse causes erratic cursor tracking ◦ Physical and/or cosmetic issues • Apple wireless trackpad has one or more of the following issues: <ul style="list-style-type: none"> ◦ No power ◦ Battery will not charge (for peripherals with embedded batteries) ◦ Swollen battery (for peripherals with embedded batteries) ◦ Battery runtime too short ◦ Will not turn off ◦ No trackpad response ◦ Trackpad click not recognized ◦ Trackpad causes erratic cursor tracking ◦ Trackpad requires high click force ◦ Trackpad click overly sensitive ◦ Force Touch or haptic feedback issue ◦ Physical and/or cosmetic issues <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Important: This troubleshooting procedure is intended only for Apple Bluetooth wireless peripheral devices, such as the following Apple products:</p> <ul style="list-style-type: none"> • Magic Mouse or Magic Mouse 2 • Magic Trackpad or Magic Trackpad 2 • Apple Wireless Keyboard or Magic Keyboard <p>For simplicity, this procedure refers to these products as wireless mouse, wireless trackpad, and wireless keyboard unless otherwise noted.</p> <p>For third-party devices, contact the manufacturer for support, software/firmware updates, or service options.</p> <ol style="list-style-type: none"> 1. Verify compatibility of the user's Apple wireless mouse, keyboard, or trackpad. Refer to HT201806: How to identify your Apple wireless mouse, keyboard, or trackpad. 2. Check for and apply the latest software and firmware updates. 3. In System Preferences, make sure Bluetooth is on and set to Discoverable. 4. For Apple Bluetooth peripherals with replaceable batteries, such as Magic Mouse, Magic Trackpad, or Apple Wireless Keyboard: If the device does not turn on, then install new or fully charged batteries. 5. For Apple Bluetooth peripherals with embedded batteries, such as Magic Mouse 2, Magic Trackpad 2, or Magic Keyboard: If the device does not turn on, then connect a known-good USB Power Adapter and Lightning cable to the device to charge it for at least two minutes. Switching the device on/off button or switch to the on position will allow the device to charge more quickly than when off. 6. For Apple Bluetooth peripherals with embedded batteries such as Magic Mouse 2, Magic Trackpad 2, or Magic Keyboard, verify that the computer being used with the peripheral supports Bluetooth 4.0 or later. Computers with earlier versions of Bluetooth support will not pair with Apple Bluetooth peripherals with embedded batteries. 7. Reset Bluetooth device or delete pairing (if applicable). 8. If Bluetooth pairs normally at your service location, then research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to HT201542: Resolve Wi-Fi and Bluetooth issues caused by wireless interference. 9. Magic Mouse 2, Magic Trackpad 2, and Magic Keyboard can pair with the computer using either Bluetooth or a Lightning cable. If Bluetooth pairing is not possible due to interference or other reasons, then try pairing these products by connecting them to the known-good computer with a known-good Lightning cable. Refer to HT201178: Set up your Apple wireless mouse, keyboard, and trackpad. 10. For keyboard issues, refer to HT204540: If your Apple keyboard doesn't work and HT203162: One or more keys on the keyboard do not respond for troubleshooting tips.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Visually inspect the user's wireless mouse, wireless trackpad, or wireless keyboard for any physical, cosmetic, and liquid damage.</p> <p>On a wireless mouse or wireless trackpad, verify that the mouse or trackpad button clicks.</p> <p>On keyboards, verify that all keyboard buttons are present and can be depressed normally.</p> <p>Does the user's wireless mouse, wireless trackpad, or wireless keyboard show signs of damage?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
2.	<p>Determine whether there is a safety issue, such as fumes, excessive heat, or shock.</p> <p>Do not perform procedures that can be a safety risk to you or the user.</p> <p>Can you proceed safely?</p>	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support regarding safety procedures for this product.</p>	\$(nodeText.noSymptomCode)	
3.	<p>Isolate damage issue to either user's wireless keyboard or wireless mouse or trackpad.</p> <p>Which peripheral is damaged?</p>	Wireless keyboard	Go to step 4.	\$(nodeText.yesSymptomCode)	
		Wireless mouse or trackpad	Go to step 8.	\$(nodeText.noSymptomCode)	
4.	<p>Closely examine the user's device to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to device.</p> <p>Is damage to user's device related to liquid spill?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K90	KEYBOARD
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
5.	<p>Closely examine the user's device for any signs of physical damage that may affect operation.</p> <p>Does the user's device exhibit this symptom?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K16	KEYBOARD
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	<p>Closely examine the user's device for signs of paint wearing off of one or more keys.</p> <p>Does the user's device exhibit this symptom?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K35	KEYBOARD
		No	Go to step 7.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	Closely examine the user's device for any signs of cosmetic damage that does not affect operation.	Yes	Replace the user's wireless keyboard out of warranty.	K21	KEYBOARD
	Does the user's device exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
8.	Closely examine the user's device to determine exact nature of the issue.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K90	MOUSE
	Look for any signs of liquid spill, liquid penetration, or liquid damage to device.	No	Go to step 9.	\$(nodeText.noSymptomCode)	
	Is damage to user's device related to liquid spill?				
9.	Closely examine the user's device for any signs of physical damage that may affect operation.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K16	MOUSE
	Does the user's device exhibit this symptom?	No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	Closely examine the user's device for any signs of cosmetic damage that does not affect operation.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K21	MOUSE
	Does the user's device exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
11.	Follow steps listed in HT201171: Using a Bluetooth mouse, keyboard, or trackpad with your Mac to pair the user's Bluetooth device with a known-good Mac.	Yes	ESCALATION REQUIRED. The Bluetooth device appears to be performing to specifications. There may be an issue with the user's computer, or wireless interference in user's environment. If issue persists, then contact ACS for additional support.	\$(nodeText.yesSymptomCode)	
	Test the user's wireless mouse, wireless trackpad, or wireless keyboard manually, using built-in applications on a known-good Mac. For example, use the Notes application to check the keys on a wireless keyboard.				
	Refer to HT204621: If your Apple wireless mouse, keyboard, or trackpad aren't working as expected for tips to resolve issues.				
12.	Does the user's wireless mouse, wireless trackpad, or wireless keyboard pair and function normally?	No	Go to step 12.	\$(nodeText.noSymptomCode)	
	Isolate failure to either user's wireless keyboard or wireless mouse or trackpad.	Wireless keyboard	Go to step 13.	\$(nodeText.yesSymptomCode)	
	Which peripheral is malfunctioning?	Wireless mouse or trackpad	Go to step 29.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	Look for for any signs of power on the user's wireless keyboard, such as a power LED turning on. Note: Not all devices have a power LED.	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
	Verify that the user's wireless keyboard turns ON when the on/off button or switch is placed in the on position. Verify that the user's wireless keyboard turns off when the on/off button or switch is placed in the off position. Does the user's wireless keyboard exhibit any power-related symptoms?	No	Go to step 18.	\$(nodeText.noSymptomCode)	
14.	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard is not functioning at all (seems dead, no power, power LED does not turn on) 	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K09	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 15.	\$(nodeText.noSymptomCode)	
15.	Verify that the user's wireless keyboard turns on when the on/off button or switch is placed in the on position. Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> On/off switch or button is defective 	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K19	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 16.	\$(nodeText.noSymptomCode)	
16.	Verify that the user's wireless keyboard turns off when the on/off button or switch is placed in the off position. Confirm that the issue with the user's wireless keyboard is:	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K34	KEYBOARD
	<ul style="list-style-type: none"> User's wireless keyboard remains on when the on/off button or switch has been placed in the off position Does the user's wireless keyboard exhibit this symptom?	No	Go to step 17.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
17.	Verify if the user's wireless keyboard has any other power-related issue that is not related to the on/off button or switch.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K20	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Power Issue, not due to on/off button or switch Does the user's wireless keyboard exhibit this symptom?	No	Go to step 18.	\$(nodeText.noSymptomCode)	
18.	If the user's issue involves pairing or connecting to a Magic Keyboard, then you can connect to, pair, and use this device with the computer using either Bluetooth or a Lightning cable.	Yes	Go to step 19.	\$(nodeText.yesSymptomCode)	
	If Bluetooth pairing is not possible due to interference or other reasons, then try connecting the user's Magic Keyboard to the known-good computer with a known-good Lightning cable. For other Apple Bluetooth peripherals, select the "Yes" answer to continue. Does the user's Magic Keyboard connect and pair using USB?	No	Replace the user's wireless keyboard. Verify that the issue is resolved.	K30	KEYBOARD
19.	Verify that the known-good computer can recognize the user's wireless keyboard.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K15	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard is not recognized by known-good computer Does the user's wireless keyboard exhibit this symptom?	No	Go to step 20.	\$(nodeText.noSymptomCode)	
20.	Verify that the known-good computer can pair with the user's wireless keyboard using Bluetooth.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K07	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard cannot pair with a known-good computer Does the user's wireless keyboard exhibit this symptom?	No	Go to step 21.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
21.	Verify that the known-good computer maintains a Bluetooth connection to the user's wireless keyboard, and does not drop this connection.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K08	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard intermittently loses its connection with a known-good computer Does the user's wireless keyboard exhibit this symptom?	No	Go to step 22.	\$(nodeText.noSymptomCode)	
22.	Ask the user how often and how long the wireless keyboard is used.	Yes	Go to step 23.	\$(nodeText.yesSymptomCode)	
	Explain to the user that the battery issue could likely be caused by the user using the wireless keyboard continuously over a long period of time, rather than any fault of the wireless keyboard itself, macOS, or the user's computer. Gain agreement from the user that lengthy wireless keyboard usage is likely to be the cause of the battery life issue, and that there is no service issue with the wireless keyboard itself. Does the user agree that the battery life issue is likely caused by lengthy wireless keyboard usage?	No	Replace the user's wireless keyboard. Verify that the issue is resolved.	K32	KEYBOARD
23.	Attempt to charge the user's wireless keyboard battery for several more minutes. Verify that the user's wireless keyboard battery charge level that appears on the known-good computer that is paired with this user's wireless keyboard has increased and shows that the user's wireless keyboard is charging.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K31	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard battery will not charge Note: This symptom does not apply to peripherals with replaceable batteries. Does the user's wireless keyboard exhibit this symptom?	No	Go to step 24.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
24.	Closely inspect the user's wireless keyboard enclosure for signs of a swollen battery.	Yes	Replace the user's wireless keyboard.	K33	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard battery appears swollen <p>Note: This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 25.	\$(nodeText.noSymptomCode)	
25.	Verify that each and every wireless keyboard key functions as expected when pressed and released.	Yes	Replace the user's wireless keyboard.	K01	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> One or more keys do not work <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 26.	\$(nodeText.noSymptomCode)	
26.	Verify that each and every wireless keyboard key functions as expected when pressed and released.	Yes	Replace the user's wireless keyboard.	K05	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Keys seem to stick, do not respond properly, or respond slowly <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 27.	\$(nodeText.noSymptomCode)	
27.	Verify that each and every wireless keyboard key is intact and not missing.	Yes	Replace the user's wireless keyboard.	K27	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Keys missing or falling off <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 28.	\$(nodeText.noSymptomCode)	
28.	Verify that the wireless keyboard language is as expected.	Yes	Replace the user's wireless keyboard.	K04	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Wrong keyboard language version <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
29.	Look for for any signs of power on the user's wireless mouse or trackpad, such as a power LED turning on. Note: Not all devices have a power LED.	Yes	Go to step 30.	\$(nodeText.yesSymptomCode}	
	Verify that the user's wireless mouse or trackpad turns on when the on/off button or switch is placed in the on position.	No	Go to step 34.	\$(nodeText.noSymptomCode}	
	Verify that the user's wireless mouse or trackpad turns off when the on/off button or switch is placed in the off position.				
	Does the user's wireless mouse or trackpad exhibit any power-related symptoms?				
30.	Confirm that the issue with the user's wireless mouse or trackpad is:	Yes	Replace the user's wireless mouse or trackpad.	K09	MOUSE
	<ul style="list-style-type: none"> User's wireless mouse or trackpad is not functioning at all (seems dead, no power, power LED does not turn on) 		Verify that the issue is resolved.		
	Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 31.	\$(nodeText.noSymptomCode}	
31.	Verify that the user's wireless mouse or trackpad turns on when the on/off button or switch is placed in the on position.	Yes	Replace the user's wireless mouse or trackpad.	K19	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is:		Verify that the issue is resolved.		
	<ul style="list-style-type: none"> on/off switch or button is defective 	No	Go to step 32.	\$(nodeText.noSymptomCode}	
32.	Does the user's wireless mouse or trackpad exhibit this symptom?	Yes	Replace the user's wireless mouse or trackpad.	K34	MOUSE
	Verify that the user's wireless mouse or trackpad turns off when the on/off button or switch is placed in the off position.		Verify that the issue is resolved.		
	Confirm that the issue with the user's wireless mouse or trackpad is:	No	Go to step 33.	\$(nodeText.noSymptomCode}	
	<ul style="list-style-type: none"> User's wireless mouse or trackpad remains on when the on/off button or switch has been placed in the off position 				
	Does the user's wireless mouse or trackpad exhibit this symptom?				

	Check	Result	Action	Code	Commodity
33.	Verify if the user's wireless mouse or trackpad has any other power-related issue that is not related to the on/off button or switch.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K20	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> Power Issue, not due to on/off button or switch Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 34.	\$(nodeText.noSymptomCode)	
34.	If the user's issue involves pairing or connecting to a Magic Mouse 2 or Magic Trackpad 2, then you can connect to and pair these devices with a computer using either Bluetooth or a Lightning cable. If Bluetooth pairing is not possible due to interference or other reasons, then try connecting the user's Magic Mouse 2 or Magic Trackpad 2 to a known-good computer with a known-good Lightning cable. For other Apple Bluetooth peripherals, select the "Yes" answer to continue. Does the user's Magic Mouse 2 or Magic Trackpad 2 connect and pair using USB?	Yes	Go to step 35.	\$(nodeText.yesSymptomCode)	
		No	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K30	MOUSE
35.	Verify that the known-good computer can recognize the user's wireless mouse or trackpad. Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad is not recognized by known-good computer. Does the user's wireless mouse or trackpad exhibit this symptom?	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K15	MOUSE
		No	Go to step 36.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
36.	Verify that the known-good computer can pair with the user's wireless mouse or trackpad.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K07	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad cannot pair with a known-good computer Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 37.	\$(nodeText.noSymptomCode)	
37.	Verify that the known-good computer maintains a Bluetooth connection to the user's wireless mouse or trackpad, and does not drop this connection.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K08	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad intermittently loses its connection with a known-good computer Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 38.	\$(nodeText.noSymptomCode)	
38.	Ask the user how often and how long the wireless mouse or trackpad is used.	Yes	Go to step 39.	\$(nodeText.yesSymptomCode)	
	Gain agreement from the user that lengthy wireless mouse or trackpad usage is likely to be the cause of the battery life issue, and that there is no service issue with the wireless mouse or trackpad itself. Does the user agree that the battery life issue is likely caused by lengthy wireless device usage?	No	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K32	MOUSE

	Check	Result	Action	Code	Commodity
39.	Attempt to charge the user's wireless mouse or trackpad battery for several more minutes. Verify that the user's wireless mouse or trackpad battery charge level that appears on the known-good computer that is paired with this user's wireless mouse or trackpad has increased and shows that the user's wireless mouse or trackpad is charging.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K31	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad battery will not charge Note: This symptom does not apply to peripherals with replaceable batteries. Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 40.	\$(nodeText.noSymptomCode)	
40.	Closely inspect the user's wireless mouse or trackpad enclosure for signs of a swollen battery.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K33	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad battery appears swollen Note: This symptom does not apply to peripherals with replaceable batteries. Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 41.	\$(nodeText.noSymptomCode)	
41.	Isolate failure to either user's wireless mouse or wireless trackpad.	Wireless mouse	Go to step 42.	\$(nodeText.yesSymptomCode)	
	Which peripheral is malfunctioning?	Wireless trackpad	Go to step 45.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
42.	Verify that the overall function of the user's wireless mouse performs as expected when used with the known-good computer.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K26	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> No mouse response Does the user's wireless mouse exhibit this symptom?	No	Go to step 43.	\$(nodeText.noSymptomCode)	
43.	Verify that the clicking function of the user's wireless mouse performs as expected when pressed and released.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K14	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> Mouse clicking function not working properly Does the user's wireless mouse exhibit this symptom?	No	Go to step 44.	\$(nodeText.noSymptomCode)	
44.	Verify that the touch gesture function of the user's wireless mouse performs as expected when the mouse surface is touched.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K18	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> Touch/Multi-Touch gesture issue Does the user's wireless mouse exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
45.	Verify that the overall function of the user's wireless trackpad performs as expected when used with the known-good computer.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K23	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad cursor not responding Does the user's wireless trackpad exhibit this symptom?	No	Go to step 46.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
46.	Verify that the user's wireless trackpad exhibits smooth continuous tracking when used with the known-good computer, and does not skip or behave erratically.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K12	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad cursor not tracking properly Does the user's wireless trackpad exhibit this symptom?	No	Go to step 47.	\$(nodeText.noSymptomCode)	
47.	Verify that the clicking function of the user's wireless trackpad performs as expected when pressed and released, and that the click is recognized by the known-good computer.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K13	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad click not recognized Does the user's wireless trackpad exhibit this symptom?	No	Go to step 48.	\$(nodeText.noSymptomCode)	
48.	Verify that the user's wireless trackpad clicking function does not require excessive force when pressed and released.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K24	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad requires high click force Does the user's wireless trackpad exhibit this symptom?	No	Go to step 49.	\$(nodeText.noSymptomCode)	
49.	Verify that the user's wireless trackpad clicking function is not overly sensitive to clicking when pressed and released.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K25	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad click oversensitive Does the user's wireless trackpad exhibit this symptom?	No	Go to step 50.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
50.	Verify that the user's wireless trackpad Force Touch function performs as expected and that haptic feedback is felt in response. Note: This feature does not apply to all models.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K29	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad Force Touch or haptic feedback issue 	No	Issue cannot be duplicated.	<code> \${nodeText.noSymptomCode} </code>	
	Does the user's wireless trackpad exhibit this symptom?				

External Apple Wired Keyboard and Mouse

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<p>Apple wired USB keyboard or mouse does not function with user's computer or shows one or more of the following symptoms:</p> <ul style="list-style-type: none">• One or more mouse buttons do not click• Mouse scroll ball does not operate smoothly• No mouse response• Keys stick• Keys loose or missing• One or more keys do not respond when pressed• No keyboard response at all• Apple wired mouse causes erratic cursor tracking• Apple wired keyboard or mouse is not recognized• Apple wired keyboard or mouse has physical damage that affects operation• Paint wearing off of one or more keys• Apple wired keyboard or mouse has cosmetic damage that does not affect operation <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Disconnect all USB devices from the user's computer except for the user's mouse or keyboard. Troubleshoot only one device at a time to help isolate the issue.2. Unplug the keyboard or mouse from the USB port, wait a few seconds, and reconnect it.3. Connect the keyboard or mouse to another USB port on the user's computer.4. Make sure the USB connectors are plugged in completely and correctly.5. Visually inspect the USB connectors and ports for damage or debris.6. Try operating the user's mouse on another surface. Ask the user about the type of surface usually being used with the mouse. Glossy or transparent surfaces, or those with repetitive patterns, may cause mouse-tracking errors or faulty mouse operation. Explain that solid, nonreflective, opaque surfaces work best. The surface should be clean, but not shiny.7. Visually inspect the user's keyboard or mouse for dirt, hair, liquid damage, or other debris. Check to see if the user has pets. Pet hair can lie across the laser and cause intermittent mouse issues. Refer to HT204172: How to clean your Apple products for information on cleaning the user's keyboard or mouse.8. Connect the user's USB keyboard or mouse to an available USB port on a known-good computer to determine if the issue is related to the USB port on the user's computer, or to the user's USB keyboard or mouse. If the user's keyboard or mouse functions when used with the known-good computer, go to the "USB Port Not Recognized" troubleshooting flow.9. For keyboard issues, refer to HT204540: If your Apple keyboard doesn't work and HT203162: One or more keys on the keyboard do not respond for troubleshooting tips.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Visually inspect the user's USB mouse or keyboard to verify that the attached USB cable and connector are not damaged or frayed.</p> <p>Check user's keyboard or mouse for physical and liquid damage.</p> <p>On mice, verify that all mouse buttons click and laser tracking LED illuminates.</p> <p>On keyboards, verify that all keys are present and can be depressed normally.</p> <p>Does the user's USB mouse or keyboard, or its attached cable or connector, show signs of damage?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 12.	`\${nodeText.noSymptomCode}`	
2.	<p>Isolate damage issue to either user's wired USB keyboard or mouse.</p> <p>Which peripheral is damaged?</p>	USB Keyboard	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		USB Mouse	Go to step 9.	`\${nodeText.noSymptomCode}`	
3.	<p>Closely examine user's keyboard to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, and liquid damage to keyboard.</p> <p>Is damage to user's keyboard related to liquid spill?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K90	KEYBOARD
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	<p>Click each key to ensure no keys are sticking in the down or up position.</p> <p>Is damage to user's keyboard related to sticky keys or slow key response?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K05	KEYBOARD
		No	Go to step 5.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	Look for any loose or missing keycaps. Is damage to user's keyboard related to loose or missing keycaps?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K27	KEYBOARD
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	Closely inspect the keyboard for any signs of physical damage that may affect operation. Does the user's keyboard exhibit this symptom?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K16	KEYBOARD
		No	Go to Step 7.	\${nodeText.noSymptomCode}	
7.	Closely examine the keyboard for signs of paint wearing off of one or more keys. Does the user's keyboard exhibit this symptom?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K35	KEYBOARD
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	<p>Closely inspect the keyboard for any signs of cosmetic damage that does not affect operation.</p> <p>Does the user's keyboard exhibit this symptom?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K21	KEYBOARD
		No	Issue cannot be duplicated.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
9.	<p>Closely examine user's mouse to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, and liquid damage to mouse.</p> <p>Is damage to user's mouse related to liquid spill?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K90	MOUSE
		No	Go to step 10.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
10.	<p>Closely inspect the mouse for any signs of physical damage that may affect operation.</p> <p>Is there physical damage to user's mouse?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K16	MOUSE
		No	Go to step 11.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
11.	Closely inspect the mouse for any signs of cosmetic damage that does not affect operation.	Yes	Replace USB mouse. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K21	MOUSE
	Is there cosmetic damage to user's mouse?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	
12.	Isolate failure issue to either user's wired USB keyboard or mouse.	USB Keyboard	Go to step 17.	\${nodeText.yesSymptomCode}	
	Which peripheral is malfunctioning?	USB Mouse	Go to step 13.	\${nodeText.noSymptomCode}	
13.	Connect user's USB mouse to a free USB port on a known-good computer, and check System Information to determine whether the computer recognizes the mouse.	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
	Is mouse recognized by a known-good computer?	No	Replace USB mouse. Verify issue resolved.	K15	MOUSE
14.	Move the mouse and verify that the cursor on the known-good computer screen moves smoothly.	Yes	Replace USB mouse. Verify issue resolved.	K26	MOUSE
	Is issue related to mouse function?	No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	Click and roll the mouse's scroll ball to check that it rolls freely in all directions and with no physical resistance.	Yes	Replace USB mouse. Verify issue resolved.	K06	MOUSE
	Is issue related to the scroll ball?	No	Go to step 16.	\${nodeText.noSymptomCode}	
16.	Press the mouse's various buttons to verify that they click properly, without sticking, every time they are pressed.	Yes	Replace USB mouse. Verify issue resolved.	K14	MOUSE
	Is issue related to the mouse button(s)?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	
17.	Connect user's USB keyboard to a free USB port on a known-good computer, and check System Information to determine whether the computer recognizes the keyboard.	Yes	Go to step 18.	\${nodeText.yesSymptomCode}	
	Is keyboard recognized by a known-good computer?	No	Replace USB keyboard. Verify issue resolved.	K15	KEYBOARD

	Check	Result	Action	Code	Commodity
18.	Verify that all keys functions as expected when pressed and released.	Yes	Replace USB keyboard. Verify issue resolved.	K01	KEYBOARD
	Is issue related to specific keys not working?	No	Go to step 19.	\${nodeText.noSymptomCode}	
19.	Verify that the keyboard language is as expected.	Yes	Replace USB keyboard. Verify issue resolved.	K04	KEYBOARD
	Is issue related to keyboard language?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	

Internal Microphone Issues

Unlikely causes:

Battery, camera, camera cable, DisplayPort cable, fan, flash storage card/solid-state drive (SSD), hard disk drive (HDD), hard drive combo cable, display panel, left speaker, memory, power supply, right speaker, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Microphone not working, but audio output is functional• Microphone audio is garbled• Internal microphone input cannot be selected• Line audio input functions properly <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Identify the locations of all microphones, and check that the microphone openings are not covered by tape, sticky notes, or other obstructions. Attempt to carefully remove any obstructions and verify this resolves the issue.2. Go to System Preferences > Sound, and verify the following:<ul style="list-style-type: none">◦ Input tab:<ul style="list-style-type: none">▪ Internal Microphone is available and selected for sound input.▪ “Input volume” slider is not set to zero.◦ Output tab:<ul style="list-style-type: none">▪ Internal Speakers is available and selected for sound output.▪ “Output volume” is not muted or set to zero.3. Go to System Preferences > Sound > Input tab, and verify that the “Input level” indicator moves when speaking into the microphone.4. Check that no cables are inserted into the headphone jack. Use an otoscope to visually inspect jack. Use compressed air to clean and remove any debris.5. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.6. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.7. Check for and apply the latest software and firmware updates. <p>Warning: Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Does issue persist with a known-good OS?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`	
2.	<p>Disconnect any connected headphones or external speakers. Check whether System Preferences > Sound > Input tab shows an “Internal microphone” source available and selected.</p> <p>Does System Preferences list “External microphone” instead?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	<p>Debris in, or damage to, the headphone jack can cause the computer to become stuck in External Microphone input mode.</p> <p>Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.</p> <p>Use compressed air to clean and remove any debris.</p> <p>Is there any damage to the headphone jack?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>The headphone jack is part of the rear enclosure. Replace the rear enclosure. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple’s one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	Run AST 2 Audio Test suite to verify that built-in microphones detect expected audio test patterns produced from each speaker.	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
	Refer to TP587: Using Audio Test . Does the computer pass AST 2 Audio test suite?	No	Go to step 5.	\${nodeText.noSymptomCode}	
5.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding. Remove display panel. Locate and disconnect microphone cable from logic board. Inspect the microphone opening to ensure it is not covered by incorrect installation of a VHB strip. If VHB is covering the microphone, follow service guide procedures to remove and install the correct VHB strip in that area.	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
	The microphone is located along the lower inner side of the display panel opening in the front of the enclosure, and is connected to the logic board with a small flex cable. Inspect the cable and connector on the logic board for any damage. Is there any damage to the microphone cable or connector?	No	Go to step 7.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
6.	<p>Determine whether the damage is located on the microphone cable, the logic board, or a combination of multiple components.</p> <p>Is the damage limited to the microphone cable only?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Microphone is part of rear enclosure. Replace rear enclosure. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	<p>\$(nodeText.yesSymptomCode)</p>	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
7.	<p>Reseat the microphone cable connector to the logic board. Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Is the microphone recognized and functional?</p>	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
		No	Go to step 9.	\$(nodeText.noSymptomCode)	
8.	<p>Run AST 2 Audio Test suite to verify that built-in microphones detect expected audio test patterns produced from each speaker.</p> <p>Refer to TP587: Using Audio Test.</p> <p>Does the computer pass AST 2 Audio test suite?</p>	Yes	The issue was resolved by reseating the microphone cable. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	To troubleshoot this issue completely, a known-good logic board is required.	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to a known-good logic board?	No	Replace the logic board. Verify that the issue is resolved.	M09	MLB
10.	Substitute a known-good logic board.	Yes	Replace the logic board. Verify that the issue is resolved.	M09	MLB
	<p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Is the microphone recognized and functional?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Microphone is part of rear enclosure. Replace rear enclosure. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	\$(nodeText.noSymptomCode)	
11.	Verify that the internal microphone is available, selected, and functional, and that the input level indicator moves when speaking into the microphone. Then record a sample audio file and play it back to verify that it is free of distortion.	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
	<p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

No Audio from Internal Speakers or Headphone Jack

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, DisplayPort cable, fan, hard disk drive (HDD), hard drive data or power or combo cable, display panel, memory, power supply, solid state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">No sound from headphone jackNo sound from left or right speakers <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Use controls to increase the sound volume to medium, halfway between minimum and maximum setting.In System Preferences > Sound > Output, verify “Internal Speaker” output is available and selected.Connect headphones or external speakers to the headphone jack. In System Preferences > Sound > Output, verify whether the Internal Speakers setting switches to Headphones, and whether audio can be played on headphones or external speakers.Disconnect any device connected to the headphone jack. In System Preferences > Sound > Output, check that the sound output device reverts to Internal Speakers and that the Balance slider is set halfway between left and right.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Test the audio output using more than one application or website.Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.Check for and apply the latest software and firmware updates. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">TP833: iMac and Displays: Power Supply Cover InstructionsTP820: iMac (27-inch): SafetyTP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none">TP1620: iMac Pro (2017): Power Supply Cover InstructionsTP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the user's iMac model: A. iMac Pro (2017) (includes T2 Security Chip) B. Other iMac models Which iMac model?	A	Go to step 2.	\$(nodeText.yesSymptomCode}	
		B	Go to step 3.	\$(nodeText.noSymptomCode}	
2.	Follow steps in Restore Apple T2 firmware on iMac Pro to restore the T2 firmware on the user's computer. Restart the computer and verify that it completely starts up to macOS. Retest for speaker or headphone jack audio issue. Does the issue persist after restoring T2 firmware?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode}	
		No	The issue was resolved by restoring T2 firmware.	\$(nodeText.noSymptomCode}	
3.	Use one of the following two methods to start up the computer to a known-good macOS. Start up the computer to Internet Recovery. See HT201314: About macOS Recovery . Start up the computer to a known-good external macOS startup volume. Retest for speaker or headphone jack audio issue. Does the issue persist with a known-good macOS?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode}	
		No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.noSymptomCode}	
4.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Output tab and verify that Internal Speaker is available and selected for sound output. Does System Preferences list "Headphones" instead?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode}	
		No	Go to step 6.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Debris in, or damage to, the headphone jack can cause the computer to become stuck in Headphone or External Speaker mode.	Yes	ESCALATION REQUIRED. The headphone jack is part of the rear enclosure. Replace the rear enclosure. Verify issue resolved.	\${nodeText.yesSymptomCode}	
	Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack. Use compressed air to clean and remove any debris. Is there any damage to the headphone jack?		Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty . Contact ACS for additional support regarding warranty coverage for this part.		
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	Run AST or AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
	Refer to TP587: Using Audio Test . Does the computer pass AST 2 Audio Test suite?	No	Go to step 7.	\${nodeText.noSymptomCode}	
7.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
	Remove display panel. Locate speaker connections on logic board. Disconnect and inspect both speaker cable connectors and corresponding connectors on logic board for damage. Reconnect the left and right speakers to the logic board, verifying that the connections are all seated properly. Did you find damage to speakers or logic board connector?	No	Go to step 9.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	Determine whether damage is on the logic board, speakers, or both.	Yes	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit. Verify that the issue is resolved.	X08	OTHER ELECTRIC
	Is the damage limited to speakers?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
9.	With speaker connectors reseated to logic board, verify you can hear audio through internal speakers.	Yes	The issue was resolved by reseating cables. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	In System Preferences > Sound > Output tab, adjust Balance slider to check left and right speaker channel separation. Play music with high and low tones to check bass and tweeter performance of left and right speakers. Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed. Do internal speakers present full range of expected audio performance?	No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	To continue troubleshooting this issue, a known-good left and right speaker set is required.	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
	Internal speakers are specified to work as a matched pair and must be tested or replaced as matched pairs. Keep and identify your known-good speakers from one kit as a matched pair. Do you have immediate access to a known-good speaker set?	No	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit. Verify that the issue is resolved.	X08	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
11.	Substitute a known-good internal speaker set and verify you can hear audio through internal speakers.	Yes	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit. Verify that the issue is resolved.	X08	OTHER ELECTRIC
	Run AST or AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.	No	Reinstall the user's speakers. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M09	MLB
	Refer to TP587: Using Audio Test . Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.				
12.	Does unit pass Audio Test?				
	Connect and disconnect headphones/external speakers. Verify that audio can be played through both external and internal speakers, and that sound is clear and free of distortion.	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
	Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
	Is the issue resolved?				

No Audio to External Display Speakers

Unlikely causes:

Battery, camera, camera cable, fan, DisplayPort cable, hard disk drive (HDD), HDD combo cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> • Video but no audio to external display; audio works on internal speakers <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> 1. Gather display type and model information from the user. 2. Always use a known-good USB-C Digital AV Multiport Adapter and known-good HDMI display equipped with internal speakers to verify the issue. Review HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac or iPad Pro to help identify which adapters can be used with this computer model. 3. In System Preferences > Sound > Output, select the available DisplayPort, Thunderbolt, HDMI, or USB output device type (the output name varies depending on the display model). 4. On the HDMI display, verify that the correct input has been selected. 5. Connect the video adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer. 6. Test the audio output using more than one application or website. 7. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac. 8. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. Retest for external video issues. 9. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. 10. With the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter connected to the computer, check for and apply the latest software and firmware updates. 11. Refer to the following to learn more about Thunderbolt connectivity in this computer: <ul style="list-style-type: none"> • HT201853: About Apple video adapters and cables • HT202488: About Apple Thunderbolt cables and adapters <p>Warning: Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP833: iMac and Displays: Power Supply Cover Instructions • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> • TP1620: iMac Pro (2017): Power Supply Cover Instructions • TP1637: iMac Pro (2017): Safety

	Check	Result	Action	Code	Commodity
1.	<p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.</p> <p>Check System Preferences > Sound > Output for an available DisplayPort output device type. Select the available device type, adjust the volume level on the display, and play the audio file or source.</p> <p>Disconnect the USB-C plug, then flip it over and reconnect to test both orientations.</p> <p>Can the external display audio be selected and play audio in both plug orientations?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
2.	<p>Connect the known-good display and HDMI cable to the user's USB-C Digital AV Multiport Adapter, then to the computer.</p> <p>Check System Preferences > Sound > Output for an available HDMI output device type. Select the available device type, adjust the volume level on the display, and play the audio file or source.</p> <p>Disconnect the USB-C plug, then flip it over and reconnect to test both orientations.</p> <p>Can the external display audio be selected and play audio in both plug orientations?</p>	Yes	<p>The issue is isolated to the user's display or HDMI cable. Inform the user of findings and refer to HT204388: Connect to HDMI from your Mac for more information.</p>	\$(nodeText.yesSymptomCode)	
		No	<p>The issue is isolated to the user's adapter.</p> <p>Replace the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter.</p> <p>If user has third-party adapter, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
3.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Reinstall macOS on the user's computer.	\${nodeText.yesSymptomCode}	
	Start up the computer to Internet Recovery. See HT201314: About macOS Recovery .		Check for and apply the latest software and firmware updates.		
	Start up the computer to a known-good external macOS startup volume.	No	Verify that the issue is resolved.		
	Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.				
4.	Check System Preferences > Sound > Output for an available DisplayPort, HDMI, or USB Output device type. Select the available device type, adjust the output volume level, and play the audio file or source.	No	Go to step 4.	\${nodeText.noSymptomCode}	
	Can the external display audio be selected and play audio from a known-good macOS?				
	Inspect all USB-C receptacles and rear enclosure openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris. Important: Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage. Is any USB-C port damaged?	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M09	MLB

	Check	Result	Action	Code	Commodity
5.	<p>Inspect the opening on the rear enclosure for the USB-C receptacle. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB-C plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the rear enclosure.</p> <p>Verify that the issue is resolved.</p>	X13	ENCLOSURE
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
6.	<p>Play a known-good audio file or source and verify that the sound output to display speakers is functional.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

No Video on External Display

Unlikely causes:

Battery, camera, camera cable, fan, DisplayPort cable, hard disk drive (HDD), HDD combo cable, display panel, left speaker, memory, power supply, right speaker, flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> External display is not detected when connected to computer External display does not show any video <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> Gather display type and model information from the user. Always use a known-good USB-C Digital AV Multiport Adapter and known-good HDMI display equipped with internal speakers to verify the issue. Review HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac or iPad Pro to help identify which adapters can be used with this computer model. Refer to HT201177: Get help with video issues on external displays connected to your Mac for common causes of video issues. On the HDMI display, verify that the correct input has been selected. Connect the video adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. Retest for external video issues. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. With the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter connected to the computer, check for and apply the latest software and firmware updates. Refer to the following to learn more about Thunderbolt connectivity in this computer: <ul style="list-style-type: none"> HT201853: About Apple video adapters and cables HT202488: About Apple Thunderbolt cables and adapters <p>Warning: Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> TP833: iMac and Displays: Power Supply Cover Instructions TP820: iMac (27-inch): Safety TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> TP1620: iMac Pro (2017): Power Supply Cover Instructions TP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.</p> <p>Check System Preferences > Displays for an available external HDMI display type. Select the available device type.</p> <p>Verify that the external display can be selected and that a good image appears on the external display.</p> <p>Disconnect the USB-C plug, then flip it over and reconnect to test both orientations.</p> <p>Does a good image appear on the external display in both plug orientations?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
2.	<p>Connect the known-good display and HDMI cable to the user's USB-C Digital AV Multiport Adapter, then to the computer.</p> <p>Check System Preferences > Displays for an available external HDMI display type. Select the available device type.</p> <p>Verify that the external display can be selected and that a good image appears on the external display.</p> <p>Disconnect the USB-C plug, then flip it over and reconnect to test both orientations.</p> <p>Does a good image appear on the external display in both plug orientations?</p>	Yes	<p>The issue is isolated to the user's display or HDMI cable. Inform the user of findings and refer to HT204388: Connect to HDMI from your Mac for more information.</p>	\$(nodeText.yesSymptomCode)	
		No	<p>The issue is isolated to the user's adapter.</p> <p>Replace the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter.</p> <p>If user has third-party adapter, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
3.	<p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.</p> <p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p>	Yes	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	<p>{nodeText.yesSymptomCode}</p>	
	<p>Start up the computer to a known-good external macOS startup volume.</p> <p>Check System Preferences > Displays for an available external HDMI display type. Select the available device type.</p> <p>Verify that the external display can be selected and that a good image appears on the external display.</p> <p>Does a good image appear on the external display?</p>	No	Go to step 4.	<p>{nodeText.noSymptomCode}</p>	
4.	<p>Inspect all USB-C receptacles and rear enclosure openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>Important: Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 5.	<p>{nodeText.yesSymptomCode}</p>	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	<p>M26</p>	MLB

	Check	Result	Action	Code	Commodity
5.	<p>Inspect the opening on the rear enclosure for the USB-C receptacle. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB-C plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the rear enclosure.</p> <p>Verify that the issue is resolved.</p>	X13	ENCLOSURE
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
6.	<p>Restart the computer and verify that a known-good external display works over both VGA and digital AV adapters.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

USB Port Not Recognized

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, DisplayPort cable, hard disk drive (HDD), hard drive data or power or combo cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, solid state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Standard USB devices not recognized or not powered <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Disconnect all USB devices.Verify that the user's USB device is compatible with the computer. Refer to HT201163: Using USB devices with your Mac for more information about compatibility with various USB devices.Verify that any USB hubs connected to the computer have sufficient power for a connected USB device.Check to see whether the user's USB device requires a specific driver to function properly.Check System Information > USB device tree to see whether the computer recognizes internal USB devices (Bluetooth, IR, camera).Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates.Test each USB port using a known-good Apple wired keyboard or mouse.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect USB ports for lint, debris, or other foreign material. Remove debris with an anti-static brush.	Yes	Issue resolved. Return computer to user, explaining that debris in USB port caused issue and what to do to prevent contamination in the future.	\$(nodeText.yesSymptomCode)	
	Is known-good Apple USB device functional and recognized?	No	Go to step 2.	\$(nodeText.noSymptomCode)	
2.	Inspect all USB receptacles and rear enclosure openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection.	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
	Is any USB port damaged?	No	Go to step 4.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
3.	<p>Inspect the opening on the rear enclosure for the USB receptacle. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB port damaged or deformed?</p>	Yes	<p>Replace the rear enclosure.</p> <p>Verify that the issue is resolved.</p>	X13	ENCLOSURE
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
4.	<p>Disconnect all USB devices. Verify whether known-good Apple wired keyboard or mouse functions correctly and is recognized in System Information > USB device tree.</p> <p>Is known-good Apple USB device functional and recognized?</p>	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
5.	<p>Continue to use known-good Apple wired keyboard or mouse.</p> <p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Verify whether known-good USB device functions correctly and is recognized in System Information > USB device tree.</p> <p>Is a known-good Apple USB device functional and recognized?</p>	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M15	MLB

	Check	Result	Action	Code	Commodity
6.	<p>Use Disk Utility to repair the file directory on internal hard drive. Restart and verify whether a known-good USB device functions correctly and is recognized in System Information > USB device tree.</p> <p>Is known-good Apple USB device functional and recognized?</p>	Yes	Issue resolved by directory repair in Disk Utility. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	
7.	<p>This computer can support one high-powered USB device (iPad, iPhone, or USB hard drive for example) at a time.</p> <p>Note: The first USB device to draw more than 900 mA is allotted up to 1100 mA, while all subsequent devices are limited to 900 mA. See HT204377: Powering peripherals through USB for more information.</p> <p>Do you have immediate access to a known-good, high-powered USB device that draws over 900 mA?</p>	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
		No	Go to step 10.	\$(nodeText.noSymptomCode)	
8.	<p>Connect known-good, high-powered USB device to one of the computer's USB ports. In System Information > USB device tree, "Current Available (mA)" and "Extra Operating Current (mA)" should each report 900 mA.</p> <p>Note: The first USB device to draw more than 900 mA is allotted up to 1100 mA, while all subsequent devices are limited to 900 mA. Verify that known-good USB device functions as expected.</p> <p>Does "Extra Operating Current" appear in System Information?</p>	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M38	MLB

	Check	Result	Action	Code	Commodity
9.	<p>Connect exact same high-powered USB device to next USB port. Make sure nothing is plugged into other port(s). Both “Current Available (mA)” and “Extra Operating Current (mA)” should each report 900 mA in System Information. Repeat action with every available USB port.</p> <p>Note: The first USB device to draw more than 900 mA is allotted up to 1100 mA, while all subsequent devices are limited to 900 mA. Verify USB device operates as expected.</p> <p>Does “Extra Operating Current” appear in System Information?</p>	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	MLB
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M38	
10.	<p>Try user’s USB device with a known-good computer. Verify whether it functions normally and is recognized in System Information > USB device tree.</p> <p>Is user’s USB device functional and recognized?</p>	Yes	Issue resolved by testing USB ports and verifying user’s USB device. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	<p>Advise user to do the following:</p> <ul style="list-style-type: none"> • Contact USB device manufacturer for support. • Verify system requirements and Mac compatibility. • Find out whether device requires additional software. 	\$(nodeText.noSymptomCode)	
11.	<p>Confirm that a known-good USB device is functional and recognized.</p> <p>Check System Information for correct power allocation to USB device.</p> <p>Run AST or AST 2 Full System Diagnostic (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

USB-C and Thunderbolt Connectivity Issues

Unlikely causes:

Battery, camera, camera cable, fan, DisplayPort cable, hard disk drive (HDD), HDD combo cable, display panel, left speaker, memory, power supply, right speaker, flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> Standard USB-C devices are not recognized or not powered when connected to computer's USB-C port(s). USB 2 or USB 3 devices are not recognized or not powered when connected to computer's USB-C port(s). External DisplayPort or Thunderbolt devices or displays are not recognized when connected to computer's USB-C port(s). <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> Verify that any USB hubs connected to the computer have sufficient power for a connected USB device. Check whether the user's USB device requires a specific driver to function properly. If the user is using a USB 3 device, review HT201163: Using USB devices with your Mac. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do. Retest for USB-C connectivity issues. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Using a Wi-Fi network, check for and apply the latest software and firmware updates. Also check for adapter firmware updates by leaving the user's adapter connected to the computer while running software update. If an update is available, update the adapter's firmware before proceeding further, and retest for USB-C connectivity issues. Refer to the following articles to learn more about Thunderbolt connectivity in this computer: <ul style="list-style-type: none"> HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac or iPad Pro HT206909: Networking two Mac systems directly with a Thunderbolt 3 cable requires Thunderbolt-enabled hosts HT207113: Daisy chaining USB 2.0 devices to Thunderbolt 3 (USB-C) ports <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> TP833: iMac and Displays: Power Supply Cover Instructions TP820: iMac (27-inch): Safety TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017) refer to:</p> <ul style="list-style-type: none"> TP1620: iMac Pro (2017): Power Supply Cover Instructions TP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>If possible, also inspect the electromagnetic interference (EMI) springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
2.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	<p>Replace the rear enclosure.</p> <p>Verify that the issue is resolved.</p>	X13	ENCLOSURE
3.	<p>Using a Apple USB-C to USB Adapter, connect a known-good high-speed USB (1.1/2.0) device, such as a mouse, keyboard, or USB 2 flash drive to the same USB-C port on the computer.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 1.1/2.0 device detected?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
4.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 1.1/2.0 device detected?</p>	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
5.	<p>Using a known-good Apple USB-C to USB Adapter, connect a known-good USB 3 device, such as a USB 3 hard drive or flash drive to the same USB-C port on the computer.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 3 device detected?</p>	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
6.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 3 device detected?</p>	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	Using the user's Apple USB-C to USB Adapter in place of the known-good adapter, connect a known-good USB 3 device, such as a USB 3 hard drive or flash drive to the same USB-C port on the computer.	Yes	Go to step 8.	\$(nodeText.yesSymptomCode}	
	<p>Refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac or iPad Pro for more information about Apple USB-C adapters.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Be sure to test both orientations.</p> <p>Is the USB 3 device detected?</p>	No	<p>Replace the user's Apple USB-C adapter.</p> <p>If the adapter is made by a third party, advise the user to contact the manufacturer for support.</p> <p>Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
8.	Using a known-good Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter, connect a known-good external Thunderbolt 2 device such as a display or external disk to the same USB-C port on the computer.	Yes	Go to step 9.	\$(nodeText.yesSymptomCode}	
	<p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Refer to HT207266: About the Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter for more information about this adapter.</p> <p>Is the Thunderbolt 2 device detected?</p>	No	Go to step 14.	\$(nodeText.noSymptomCode}	
9.	Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.	Yes	Go to step 10.	\$(nodeText.yesSymptomCode}	
	<p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Is the Thunderbolt 2 device detected?</p>	No	Go to step 14.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
10.	Using the user's Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter in place of the known-good adapter, connect a known-good external Thunderbolt 2 device such as a display or external disk to the same USB-C port on the computer.	Yes	Go to "No Video on External Display" troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	<p>Refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac or iPad Pro for more information about Apple USB-C adapters.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Be sure to test both orientations.</p> <p>Is the Thunderbolt 2 device detected?</p>	No	<p>Replace the user's Apple USB-C adapter.</p> <p>If the adapter is made by a third party, advise the user to contact the manufacturer for support.</p> <p>Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
11.	<p>Inspect all USB-C ports on the computer for any visible damage or debris that may be preventing a connection.</p> <p>Also inspect the EMI springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p>Clear any debris as necessary.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 12.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
12.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> • USB device not detected. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M37	MLB
		No	Go to step 13.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
13.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> • USB port has insufficient power. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M38	MLB
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M15	MLB

	Check	Result	Action	Code	Commodity
14.	<p>Inspect all USB-C ports on the computer for any visible damage or debris that may be preventing a connection.</p> <p>Also inspect the EMI springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p>Clear any debris as necessary.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 15.	\$(nodeText.noSymptomCode)	
15.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> Thunderbolt display functionality issue. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M32	MLB
		No	Go to step 16.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
16.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> Thunderbolt not providing enough power. <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M34	MLB
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M33	MLB
17.	<p>Confirm that known-good USB high-speed and SuperSpeed devices and Thunderbolt devices are functional and recognized when connected to all USB-C ports on the computer, in both orientations.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

HDD Noisy

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, DisplayPort cable, hard drive data or power or combo cable, display panel, left speaker, logic board, memory, power supply, rear enclosure, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<p>Note: Be sure you understand what type of hard drive noise you should be concerned about, and what noises you can safely ignore. The following descriptions help distinguish normal, functional hard drive sounds from noises that may indicate drive malfunction.</p> <p>Noises such as occasional quiet chirping or beeping are typically normal hard drive sounds.</p> <p>Refer to TS3204: Evaluating System noises to determine whether noise is within expected range.</p> <p>Abnormal noises such as grinding or loud, repeated clicking or scraping sounds may be indications of a more serious issue.</p> <p>Listen closely in a quiet environment for the following:</p> <ul style="list-style-type: none">Noise during start upNoise during operationNoise when drive copies or saves data <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Important: Always ask whether user's data has been backed up prior to repair.</p> <ol style="list-style-type: none">Verify that user's issue involves only abnormal sounds, as defined in symptoms.Compare hard drive noise to a known-good equivalent computer. Refer to TS3204: Evaluating System noises to determine if noise is within expected range.Check for and apply latest software and firmware updates.If the computer model is internally equipped with both a hard disk drive (HDD) and a solid-state drive (SSD), refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">TP833: iMac and Displays: Power Supply Cover InstructionsTP820: iMac (27-inch): SafetyTP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 2.	<code>\$(nodeText.yesSymptomCode)</code>	
	Start up the computer to Internet Recovery. See HT201314: About macOS Recovery .	No	Go to "HDD, SSD, or Flash Storage Not Recognized, Not Mounting, or Read/Write Issues" troubleshooting flow.	<code>\$(nodeText.noSymptomCode)</code>	
	Start up the computer to a known-good external macOS startup volume.				
	Does hard drive appear in Disk Utility?				

	Check	Result	Action	Code	Commodity
2.	Verify that hard drive SMART status in Disk Utility shows as Verified. Is SMART status Verified?	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	Go to “HDD, SSD, or Flash Storage Not Recognized, Not Mounting, or Read/Write Issues” troubleshooting flow.	\$(nodeText.noSymptomCode)	
3.	Use Disk Utility to repair hard disk directory. Did Disk Utility repair directory or finish without error?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Erase and install macOS. Check for and apply the latest software and firmware updates. Important: Always ask whether user’s data has been backed up prior to repair. Did installation successfully finish, and did computer start up to the desktop?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to “HDD, SSD, or Flash Storage Not Recognized, Not Mounting, or Read/Write Issues” troubleshooting flow.	\$(nodeText.noSymptomCode)	
5.	Restart computer and listen closely for abnormal noise. Has abnormal noise been eliminated?	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	Disconnect internal hard drive. Start up the computer to a known-good external macOS startup volume. Has noise been eliminated?	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Go to “Noise, Hum, or Vibration” troubleshooting flow.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	<p>To confirm that drive is mounted properly, remove hard drive and verify the following:</p> <ul style="list-style-type: none"> • Rubber vibration isolation bumper is properly installed around hard drive, and does not appear worn, cracked, out-of-position, or otherwise damaged. • Hard drive bracket is securely positioned over hard drive, is fastened to rear enclosure with appropriate screws, and does not appear loose, bent, or otherwise damaged. • Any other internal components that were loosened during take-apart process have been retightened. For example, power supply or speaker screws may need to be loosened to gain access to hard drive bracket. After this is done, these components must be retightened to ensure they do not cause noise due to loose components vibrating against other parts, or against enclosure, especially around the chin area. <p>Are hard drive mounting components undamaged and installed properly?</p>	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace missing or damaged components:</p> <ul style="list-style-type: none"> • Hard drive bracket • Rubber vibration isolation bumper 	X13	PIECE PART
8.	<p>To troubleshoot this issue completely, a known-good hard drive is required.</p> <p>Do you have immediate access to a known-good hard drive?</p>	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
		No	Replace hard drive. Verify issue resolved.	H06	HDD
9.	<p>Substitute a known-good hard drive and retest.</p> <p>Has noise been eliminated?</p>	Yes	Replace hard drive. Verify issue resolved.	H06	HDD
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	H99	

	Check	Result	Action	Code	Commodity
10.	Confirm that computer no longer makes any abnormal noises.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	<p>If help is needed, record a sample audio file to review with ACS.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	H99	

HDD, SSD, or Flash Storage Not Recognized, Not Mounting, or Read/Write Issues

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, CPU fan, DisplayPort cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> Starts up to a black screen with Apple logo. Displays a flashing folder with question mark or prohibitory symbol. Cannot save documents. Displays read/write error messages. Not responding when accessing or saving data. Drive or volume is not recognized in Disk Utility (icon is grayed out), after a failed data migration to a Mac with Fusion Drive or solid-state drive (SSD) / flash storage. Cannot erase volume, and startup drive is not shown in Disk Utility. <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Important: Always ask whether user's data has been backed up prior to repair.</p> <p>Important: Some Macs that have been updated to macOS High Sierra may not start up to the internal startup volume after logic board replacement. On affected Macs, the Mac BootROM Updater is available to address this issue. This utility updates the EFI BootROM on affected Macs to allow starting up to a volume that has been updated to the APFS file system.</p> <p>If the user's computer does not start up to the internal startup volume after logic board replacement, run the Mac BootROM Updater to ensure the replacement logic board's EFI BootROM firmware is updated to the latest version that supports the APFS file system.</p> <p>For more information and instructions for downloading and using the Mac BootROM Updater, see OP476: Latest Apple Service Toolkit download links and documentation.</p> <ol style="list-style-type: none"> 1. Disconnect all peripherals and attempt to start up computer. 2. To restore default startup disk, reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac. 3. Reset SMC using procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. 4. If the computer is internally equipped with both a hard disk drive (HDD) and a solid-state drive (SSD) / flash storage, refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes. <p>Important: Using Disk Utility to erase or partition a Fusion Drive or SSD might leave the drive without a usable partition. If this occurs, follow the steps in HT205401: Use Terminal to recover an unusable Fusion Drive or SSD disk partition and reinstall Mac OS X El Capitan and later to resolve the issue.</p> <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> TP833: iMac and Displays: Power Supply Cover Instructions TP820: iMac (27-inch): Safety TP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a known-good Apple wired keyboard and Apple wired mouse to user's computer.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode}	
	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>During startup, allow up to four minutes for a defective startup drive to time out, after which the computer will start up from a known-good external device.</p> <p>Does the computer start up from a known-good macOS?</p>	No	Go to “Will Not Start Up” troubleshooting flow.	\$(nodeText.noSymptomCode}	
2.	Run AST or AST 2 Storage Diagnostic suite on the user's computer and examine the results of the test.	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	H99	
	Do all internal drive tests pass?	No	Go to step 3.	\$(nodeText.noSymptomCode}	
3.	Examine Storage Diagnostic results for presence of an internal drive.	Pass	Go to step 4.	\$(nodeText.yesSymptomCode}	
	Does the computer pass or fail drive presence test?	Fail	Go to step 13.	\$(nodeText.noSymptomCode}	
4.	Examine Storage Diagnostic results for SMART status.	Pass	Go to step 5.	\$(nodeText.yesSymptomCode}	
	Does the computer pass or fail SMART test?	Fail	Go to step 9.	\$(nodeText.noSymptomCode}	
5.	Examine Storage Diagnostic results for Short Random Multi-Block Read Test.	Pass	Go to step 6.	\$(nodeText.yesSymptomCode}	
	Does the computer pass or fail Short Random Multi-Block Read Test?	Fail	Go to step 13.	\$(nodeText.noSymptomCode}	
6.	Examine Storage Diagnostic results for File System Check.	Pass	Go to step 7.	\$(nodeText.yesSymptomCode}	
	Does the computer pass or fail File System Check?	Fail	Go to step 10.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	Examine Storage Diagnostic results for Bootable Volume Presence Check.	Pass	Go to step 8.	\$(nodeText.yesSymptomCode)	
	Does the computer pass or fail Bootable Volume Check?	Fail	Go to step 10.	\$(nodeText.noSymptomCode)	
8.	Examine Storage Diagnostic results for Last OS Reinstall Check.	Pass	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	H99	
	Does the computer pass or fail Last OS Reinstall Check?	Fail	Go to step 10.	\$(nodeText.noSymptomCode)	
9.	Identify the type of storage device affected: <ul style="list-style-type: none">• Hard disk drive (HDD)• Flash storage / solid-state drive (SSD)	HDD	Replace the user's hard drive. Verify issue resolved.	H05	HDD
	Is the affected device an HDD or SSD?	SSD	Replace the user's SSD or flash storage. Verify issue resolved.	H05	SSD
10.	Start up the computer to macOS Recovery. See HT201314: About macOS Recovery .	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
	Use Disk Utility to repair the user's internal startup drive. Attempt to start up the user's computer from its internal startup drive. Does the computer start up successfully from its internal startup drive?	No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
11.	Start up the computer to macOS Recovery or a known-good external macOS startup volume. Run Disk Utility and select the user's internal startup drive.	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
	<p>Erase the startup drive using Mac OS Extended (Case-sensitive, Journaled) format and GUID Partition Map scheme.</p> <p>Erase the startup drive again using Mac OS Extended (Journaled) format and GUID Partition Map scheme.</p> <p>Formatting the drive twice with different partition map schemes will force a rewrite of the partitions table.</p> <p>Refer to HT204743: Partition a problematic drive two times before recommending service or replacement for more information.</p> <p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Does the computer start up successfully from its internal startup drive?</p>	No	Go to step 13.	\$(nodeText.noSymptomCode)	
12.	Run AST or AST 2 Storage diagnostic test suite on the user's computer again and examine the results of the test.	Yes	The issue was resolved by repairing the internal startup drive. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Do all internal drive tests pass?	No	Go to step 13.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding. Remove display panel. Attempt to isolate which mass storage component is involved with this issue: <ul style="list-style-type: none">• Hard disk drive (HDD)• Flash storage / solid-state drive (SSD) Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.	HDD	Go to step 14.	\$(nodeText.yesSymptomCode)	
		SSD	Go to step 20.	\$(nodeText.noSymptomCode)	
		Is this an HDD or SSD Issue?			
14.	Disconnect and inspect the hard drive data and power cables from the logic board. Look for damage on logic board connectors and both cable connectors. Check for damaged or corroded cable connectors and missing or bent pins on logic board connectors. Did you find damage to hard drive cables or logic board connectors?	Yes	Go to step 15.	\$(nodeText.yesSymptomCode)	
		No	Go to step 16.	\$(nodeText.noSymptomCode)	
15.	Damage to multiple parts requires an escalation to ACS for repair approval. Is damage limited to hard drive cables?	Yes	Replace hard drive data and power cables, or hard drive combo cable (depending on model). Verify issue resolved.	X03	INTERNAL CABLE
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	P99	

	Check	Result	Action	Code	Commodity
16.	Reconnect the hard drive data and power cables to the logic board.	Yes	Issue resolved by reseating hard drive cable. Verify issue resolved.	\$(nodeText.yesSymptomCode)	
	Run AST or AST 2 Storage diagnostic test suite on the user's computer again and examine the results of the test.	No	Go to step 17.	\$(nodeText.noSymptomCode)	
	Do all internal drive tests pass?				
17.	To troubleshoot this issue completely, the following known-good parts are required:	Yes	Go to step 18.	\$(nodeText.yesSymptomCode)	
	<ul style="list-style-type: none"> • Hard drive • Hard drive data and power cables, or hard drive combo cable (depending on model). 	No	Replace hard drive. Verify issue resolved.	H01	HDD
	Do you have immediate access to each of these known-good parts?				
18.	Substitute known-good hard drive data and power cables, or hard drive combo cable (depending on model) to test with user's hard drive.	Yes	Replace hard drive data and power cables, or hard drive combo cable (depending on model). Verify issue resolved.	X03	INTERNAL CABLE
	Run AST or AST 2 Storage diagnostic test suite on the user's computer again and examine the results of the test.	No	Go to step 19.	\$(nodeText.noSymptomCode)	
	Do all internal drive tests pass?				
19.	Continue to use known-good hard drive cable and substitute a known-good hard drive.	Yes	Replace hard drive. Reinstall user's hard drive cable. Verify issue resolved.	H01	HDD
	Run AST or AST 2 Storage diagnostic test suite on the user's computer again and examine the results of the test.	No	Replace logic board. Reinstall user's hard drive and cable. Verify issue resolved.	M19	MLB
	Do all internal drive tests pass?				
20.	Disconnect and inspect SSD or flash storage. Look for damage on logic board connector and SSD or flash storage.	Yes	Go to step 21.	\$(nodeText.yesSymptomCode)	
	Check for damaged or corroded card edge connectors and missing or bent pins on logic board connector.	No	Go to step 22.	\$(nodeText.noSymptomCode)	
	Did you find damage to SSD or flash storage or logic board connectors?				

	Check	Result	Action	Code	Commodity
21.	<p>Damage to multiple parts requires an escalation to ACS for repair approval.</p> <p>Is damage limited to SSD card or flash storage?</p>	Yes	Replace SSD or flash storage. Verify issue resolved.	H01	SSD
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	P99	
22.	<p>Reconnect SSD or flash storage to logic board.</p> <p>Run AST or AST 2 Storage diagnostic test suite on the user's computer again and examine the results of the test.</p> <p>Do all internal drive tests pass?</p>	Yes	Issue resolved by reseating SSD or flash storage. Verify issue resolved.	\$(nodeText.yesSymptomCode)	
		No	Go to step 23.	\$(nodeText.noSymptomCode)	
23.	<p>To troubleshoot this issue completely, a known-good SSD or flash storage is required.</p> <p>Do you have immediate access to known-good SSD or flash storage?</p>	Yes	Go to step 24.	\$(nodeText.yesSymptomCode)	
		No	Replace SSD or flash storage. Verify issue resolved.	H01	SSD
24.	<p>Substitute a known-good SSD or flash storage.</p> <p>Run AST or AST 2 Storage diagnostic test suite on the user's computer again and examine the results of the test.</p> <p>Do all internal drive tests pass?</p>	Yes	Replace SSD or flash storage. Verify issue resolved.	H01	SSD
		No	Replace logic board. Reinstall the user's SSD or flash storage. Verify issue resolved.	M19	MLB
25.	<p>Confirm that the computer can successfully start up from the internal HDD, SSD, or flash storage.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	H99	

SD Memory Card Cannot Be Inserted Into Slot

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, DisplayPort cable, hard disk drive (HDD), HDD data or power or combo cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Cannot insert SD card into slot• Can insert SD card only part way into slot• Card slot does not align with enclosure <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Check that the user's SD card is not warped or damaged, and that the metal contacts are clean, intact and corrosion-free.2. Verify that the SD card is the correct size. Card dimensions should be 32 mm x 24 mm x 2.1 mm. Note: Cards thicker than 2.1 mm are too thick and may damage the card slot if inserted. Thinner cards such as MultiMediaCards (MMC) are acceptable. Refer to HT204384: About the SD and SDXC card slot on your Mac for further information.3. Verify that the computer's SD card slot is not obstructed in any way. Use a flashlight to look into slot to make sure nothing is already inserted. If so, carefully remove the obstruction from the slot. Try to reinsert the SD card. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none">• TP1620: iMac Pro (2017): Power Supply Cover Instructions• TP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Insert known-good, formatted SD card into user's computer. Verify that it seats correctly.</p> <p>Does known-good SD card seat correctly when inserted?</p>	Yes	<p>Issue resolved. Defective or incompatible SD card. Advise user to contact SD card vendor for support. Refer them to HT204384: About the SD and SDXC card slot on your Mac for further information.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 2.	\${nodeText.noSymptomCode}	
2.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel.</p> <p>Remove chin strap to avoid bending or damaging it while aligning logic board.</p> <p>Loosen but do not remove all logic board screws. You should be able to shift board position slightly, both left to right and up and down. Take care to avoid damaging cabling or other components while moving logic board.</p> <p>Insert known-good SD card again.</p> <p>Can you now insert known-good SD card correctly?</p>	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M27	MLB

	Check	Result	Action	Code	Commodity
3.	<p>Hold the logic board in position and tighten all logic board screws. Insert the known-good SD card again.</p> <p>Can you now insert and remove known-good SD card correctly?</p>	Yes	Issue resolved with logic board alignment. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M27	MLB
4.	<p>Verify that a known-good SD memory card can be fully inserted into and ejected from slot and that it seats correctly.</p> <p>Run AST or AST 2 Full System Diagnostic (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

SD Memory Card Not Recognized

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, DisplayPort cable, hard disk drive (HDD), HDD data or power or combo cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, solid-state drive (SSD) / flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">SD card does not appear on desktop or in System Information <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Make sure the SD card is unlocked.Check that the user's SD card is not warped or damaged and that the metal contacts are clean, intact, and corrosion free.Verify that the computer's SD card slot is not damaged or obstructed. Use a flashlight to inspect the slot to make sure nothing is already inserted. If so, carefully remove the obstruction from the slot. Try to reinsert the SD card.Verify that the SD card is the correct size. Card dimensions should be 32 mm x 24 mm x 2.1 mm. Note: Cards thicker than 2.1 mm are too thick and may damage card slot if inserted. Thinner cards such as MultiMediaCards (MMC) are acceptable. Refer to HT204384: About the SD and SDXC card slot on your Mac for further specifications.Consult HT204384: About the SD and SDXC card slot on your Mac and check for compatible SD card type and format.<ul style="list-style-type: none">SD card slot can accommodate cards that are Standard SD (Secure Digital) 4MB to 2GB, SDHC (Secure Digital High Capacity) 4GB to 32GB, and SDXC (Secure Digital Extended Capacity) 4GB to 2TB. MMC cards can also be used in this slot.While SDIO (Secure Digital Input Output) cards fit into and should not damage the card slot, they are not supported.MiniSD and Micro SD cards require adapters.For a more specific SD card type or format (wireless-enabled SD card or other SD card for example), make sure the correct driver is installed. macOS supports only standard SD memory cards; other cards may require specific driver software.Make sure Finder Preferences > General is set to show External Disks.Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Insert a known-good, formatted SD card into user's computer. Verify that card seats correctly.</p> <p>Does known-good SD card seat correctly when inserted?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to "SD Memory Card Cannot Be Inserted Into Slot" troubleshooting flow.	\$(nodeText.noSymptomCode)	
2.	<p>Verify that a known-good SD card appears in Disk Utility and mounts in Finder. Verify that computer can read data from and write data to card.</p> <p>Can computer read from and write to known-good SD card?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Verify that a known-good SD card appears and mounts in Disk Utility.</p> <p>Repair permissions and directory using Disk Utility. If issue persists, Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates.</p> <p>Retest to verify resolution.</p> <p>Can computer now read from and write to known-good SD card?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the logic board, which includes SD card reader.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M27	MLB
4.	<p>Insert user's SD card into user's computer. Verify that it seats correctly.</p> <p>Does user's SD card seat correctly when inserted?</p>	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	<p>Defective or incompatible SD card. Advise user to contact SD card manufacturer for support. Refer user to HT204384: About the SD and SDXC card slot on your Mac for further information.</p>	\$(nodeText.noSymptomCode)	
5.	<p>Verify that SD card appears in left column of Disk Utility. If card does not appear, eject and reinsert card. If inserted too slowly, card may not appear.</p> <p>Does SD card appear in Disk Utility?</p>	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
6.	Insert user's SD card into a known-good computer. Verify that computer can read data from and write data to SD card.	Yes	Repair permissions and directory using Disk Utility. If issue persists, Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Retest to verify resolution.	\$(nodeText.yesSymptomCode)	
	Can a known-good computer read from and write to user's SD card?	No	Defective or incompatible SD card. Advise user to contact SD card manufacturer for support. Refer user to HT204384: About the SD and SDXC card slot on your Mac for further information.	\$(nodeText.noSymptomCode)	
7.	Verify that user's SD card volume appears in Disk Utility and mounts in Finder.	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
	Does card volume mount in Finder or Disk Utility?	No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	Format user's SD Card as macOS Extended Journaled with a GUID partition scheme.	Yes	Issue resolved by reformatting SD card. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Important: Make sure user has a valid backup first. If formatting is successful, retest SD card by writing data to and retrieving data from card. Were you able to reformat, then write to and read from the card successfully?	No	Defective or incompatible SD card. Advise user to contact SD card manufacturer for support. Refer user to HT204384: About the SD and SDXC card slot on your Mac for further information.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	<p>Test user's SD card by writing data to and retrieving data from card.</p> <p>Were you able to write to and read from user's card successfully?</p>	Yes	<p>Verify issue resolved.</p> <p>If the issue persists, contact ACS for additional support.</p>	M99	
		No	<p>Defective or incompatible SD card. Advise user to contact SD card manufacturer for support. Refer user to HT204384: About the SD and SDXC card slot on your Mac for further information.</p>	\${nodeText.noSymptomCode}	
10.	<p>Verify that user's computer can successfully read from and write to a known-good SD card.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

Burning Smell or Odor

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer emits a burning, smoky, or other unusual odor. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Disconnect all third-party devices to eliminate external devices as source of odor.Inspect the enclosure and components for obvious signs of burning or smoky residue. Check the rear vents, slots, ports, and power cord.Clean the enclosure to eliminate any causes due to external contamination.Verify that the vents allow unobstructed airflow into and out of the computer. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">TP833: iMac and Displays: Power Supply Cover InstructionsTP820: iMac (27-inch): SafetyTP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none">TP1620: iMac Pro (2017): Power Supply Cover InstructionsTP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Determine whether this is a safety issue.</p> <p>Do not perform procedures that can be a safety risk to you or the user.</p> <p>Have you identified a safety issue?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for safety-related issues. Refer to OP44: Handling Potential Product Safety Issues.</p> <p>Retail: Document the issue and escalate following the steps in RS60: Product Safety Escalations.</p>	<p> <code>\${nodeText.yesSymptomCode}</code> </p>	
		No	Go to step 2.	<p> <code>\${nodeText.noSymptomCode}</code> </p>	
2.	<p>An odor can be related to external contamination. Inspect the computer exterior for contamination or lack of cleanliness.</p> <p>Can you determine that the odor is caused by external contamination?</p>	Yes	Go to step 3.	<p> <code>\${nodeText.yesSymptomCode}</code> </p>	
		No	Go to step 4.	<p> <code>\${nodeText.noSymptomCode}</code> </p>	
3.	<p>Thoroughly clean enclosure and all external surfaces. Refer to HT204172: How to clean your Apple products. Explain the cause to the user.</p> <p>Does user agree that the odor is due to external contamination?</p>	Yes	The issue is resolved. Verify resolution.	<p> <code>\${nodeText.yesSymptomCode}</code> </p>	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	<p>X99</p>	
4.	<p>Odors can be related to product newness. Refer to HT202324: Odors may be present short-term.</p> <p>Can you determine that the odor is due to the product being new?</p>	Yes	Go to step 5.	<p> <code>\${nodeText.yesSymptomCode}</code> </p>	
		No	Go to step 6.	<p> <code>\${nodeText.noSymptomCode}</code> </p>	

	Check	Result	Action	Code	Commodity
5.	<p>Explain to the user that new computers can sometimes emit an odor, similar to odors generated from new carpeting or a new car. In most cases, the odor dissipates after a brief period.</p> <p>Does the user agree that the odor is related to the computer being new?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
6.	<p>Closely inspect internal components and the enclosure for indications of physical damage or contamination.</p> <p>Can you identify signs of internal damage or contamination?</p>	Yes	Go to the “Mechanical, Physical, or Cosmetic Damage” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
7.	<p>Refer to TP1150: Visual/Mechanical Inspection (VMI) Guide for Mac Liquid Damage for guidance regarding possible liquid damage to the user’s computer.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	Go to the “Mechanical, Physical, or Cosmetic Damage” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	<p>Closely inspect internal hardware and the enclosure for other possible causes of odor, such as bulging or vented chip capacitors, or visible residue or burn marks on the enclosure, logic board, or other components.</p> <p>Have you identified a component failure as the source of the odor?</p>	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
		No	The issue cannot be duplicated.	`\${nodeText.noSymptomCode}`	
9.	<p>Run the computer for several hours and monitor for the issue/odor. Run the full system diagnostics available in AST or AST 2. If no functional failure is detected, use correct positioning to explain to the user that the odor is related to external contamination or the computer being new.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Computer Runs Hot

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, DisplayPort cable, hard drive data or power or combo cable, left speaker, memory, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> • Computer feels unusually warm • Fan is not operating • Fan is not functioning to its full capacity • Fan runs constantly at high speeds <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> 1. Run Mac Resource Inspector (MRI) diagnostic suite to verify correct operation of sensors and fan. 2. Check for and apply latest software and firmware updates. 3. Inspect fan performance during operation to make sure fan is spinning. Check that vents are not blocked, and if necessary, use compressed air to remove dust or debris from rear fan exhaust. 4. Compare computer's operating temperature to a known-good, similarly configured computer. 5. Check for runaway applications using the information in HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity. Follow the instructions to halt any processes that are using excessive system resources. 6. Processor-intensive/graphics-intensive applications and system processes may cause the enclosure to feel warm. Use Activity Monitor to identify these types of programs and explain issue to user. 7. Reset SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do. 8. Verify that computer's internal hard drive or flash storage is an Apple-installed part. Compare hard drive information in System Information to the Apple Hard Drives Matrix in SM155: Hard Drives Matrix to determine whether user's installed drive is one of OEM drives available for this computer configuration. Third-party hard drives without correct firmware or thermal sensors, or outside this computer's specifications, may cause computer to run hot or permanently activate fan at full speed. In such cases, inform user that computer has been modified from its original, supported configuration, and that such a repair would not be covered under Apple warranty. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP833: iMac and Displays: Power Supply Cover Instructions • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> • TP1620: iMac Pro (2017): Power Supply Cover Instructions • TP1637: iMac Pro (2017): Safety

	Check	Result	Action	Code	Commodity
1.	Run Mac Resource Inspector (MRI) diagnostic suite and consult diagnostic results to check for fan (motor) or sensor failures.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<p>An inoperative or clogged fan can cause the computer to run hot.</p> <p>Sensor(s) that indicate they are out of normal operating range can help isolate why the computer is running hot.</p> <p>Does computer pass all MRI checks?</p>	No	Go to step 8.	`\${nodeText.noSymptomCode}`	
2.	<p>Use extended version of Cooling System Diagnostics (CSD) to verify proper function of the following subsystems:</p> <ul style="list-style-type: none"> • SMC • Fan • Thermal sensors • CPU–heat sink thermal interface <p>Does computer pass all CSD tests?</p>	Yes	Computer passed all CSD tests. Verify operation and refer user to HT202179: About fans and fan noise in your Apple product .	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel.</p> <p>Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseal fan cable connections to logic board. Reassemble and retest with CSD.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Does computer pass all CSD checks?</p>	Yes	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	To troubleshoot this issue completely, a known-good fan is required. Do you have immediate access to known-good fan?	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
5.	Substitute a known-good fan and retest using MRI and CSD. Does computer now pass MRI and CSD tests?	Yes	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	To troubleshoot this issue completely, a known-good logic board is required. Do you have immediate access to a known-good logic board?	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Reinstall user's fan. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M18	MLB

	Check	Result	Action	Code	Commodity
7.	<p>Continue to use known-good fan. Substitute a known-good logic board. Reassemble computer and retest with MRI.</p> <p>Do both known-good fan and logic board pass MRI and run-in tests?</p>	Yes	<p>Reinstall user's fan.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
		No	Replace power supply. Verify issue resolved.	P17	POWER SUPPLY
8.	<p>Determine specific type of failure reported in diagnostics: thermal/fan sensor or voltage/current sensor.</p> <ul style="list-style-type: none"> • MRI thermal sensors begin with Txxx. • MRI electrical voltage sensors begin with Vxxx. • MRI electrical current sensors begin with Ixxx. <p>Which sensor failure does diagnostics report?</p>	Voltage/Current Sensor	Go to step 9.	$\text{\$}\{\text{nodeText.yesSymptomCode}\}$	
		Thermal/Fan Sensor	Go to step 15.	$\text{\$}\{\text{nodeText.noSymptomCode}\}$	

	Check	Result	Action	Code	Commodity
9.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel.</p> <p>Some power-related sensors are located in power supply, but are read through a SMBus connection to logic board.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Does MRI report a VDxx or IDxx test failure?</p>	Yes	Go to step 10.	`\${nodeText.yesSymptomCode}`	
		No/Other	Go to step 13.	`\${nodeText.noSymptomCode}`	
10.	<p>Reseat DC power cable connection to logic board. Reassemble and retest, using MRI.</p> <p>Does MRI still report a VDxx or IDxx sensor test failure?</p>	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
		No	Issue resolved by reseating DC power cable connection between power supply and logic board. Verify resolution.	`\${nodeText.noSymptomCode}`	
11.	<p>To troubleshoot this issue completely, a known-good power supply is required.</p> <p>Do you have immediate access to a known-good power supply?</p>	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	<p>DC power cable is part of power supply.</p> <p>Replace power supply.</p> <p>Verify that the issue is resolved.</p>	P17	POWER SUPPLY

	Check	Result	Action	Code	Commodity
12.	<p>Substitute a known-good power supply, reassemble and retest using MRI.</p> <p>Does MRI still report a VDxx or IDxx sensor test failure?</p>	Yes	<p>Reinstall user's power supply.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
		No	<p>DC power cable is part of power supply.</p> <p>Replace power supply.</p> <p>Verify that the issue is resolved.</p>	P17	POWER SUPPLY
13.	<p>Most voltage and current regulators are located on logic board. To troubleshoot this issue completely, a known-good logic board is required.</p> <p>Do you have immediate access to a known-good logic board?</p>	Yes	Go to step 14.	<p> <code> \${nodeText.yesSymptomCode} </code> </p>	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M18	MLB

	Check	Result	Action	Code	Commodity
14.	Substitute a known-good logic board, reassemble and retest using MRI. Does MRI still report a Vxxx or lxxxx sensor test failure?	Yes	Reinstall user's logic board. Replace power supply. Verify issue resolved.	P17	POWER SUPPLY
		No	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M18	MLB
15.	Identify specific type of failure reported in MRI/diagnostics: thermal sensor or fan (motor) error. MRI thermal sensors begin with Txxx. Which sensor failure does diagnostics report?	Fan (Motor)	Go to step 16.	`\${nodeText.yesSymptomCode}`	
		Thermal	Go to step 22.	`\${nodeText.noSymptomCode}`	
16.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding. Remove display panel. Refer to the service guide Functional Overview to locate affected fan connection to logic board. Disconnect fan cable connectors and inspect logic board and fan cable connector pins for damage. Is there any cable or connector damage on fan or logic board?	Yes	Go to step 17.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 19.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
17.	<p>Identify whether fan, logic board, or both are damaged.</p> <p>Are both fan and logic board damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 18.	\${nodeText.noSymptomCode}	
18.	<p>Identify whether fan or logic board is damaged.</p> <p>Which part is damaged?</p>	Fan	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
		Logic Board	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
19.	<p>Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseal fan cable connections to logic board. Reassemble and retest with MRI.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Does computer pass fan motor check?</p>	Yes	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	Go to step 20.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
20.	To troubleshoot this issue completely, a known-good fan is required. Do you have immediate access to a known-good fan?	Yes	Go to step 21.	\${nodeText.yesSymptomCode}	
		No	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
21.	Substitute a known-good fan, and retest using MRI. Does computer now pass fan motor check?	Yes	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
		No	Reinstall user's fan. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M08	MLB

	Check	Result	Action	Code	Commodity
22.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Go to step 23.	\${nodeText.yesSymptomCode}	
	<p>Remove display panel.</p> <p>Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseal fan cable connections to logic board. Reassemble and retest with MRI.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Does MRI still report a Txxx thermal sensor test failure?</p>	No	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	\${nodeText.noSymptomCode}	
23.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the logic board.</p> <p>Refer to service documentation for information about thermal sensors.</p> <p>Is a logic board thermal sensor failing a test?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M23	MLB
		No	Go to step 24.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
24.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the Hard Disk Drive (HDD) or Flash Storage.</p> <p>Note: Some models do not have a HDD.</p> <p>Is a hard drive or flash storage thermal sensor failing a test?</p>	Yes	Go to step 25.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 29.	`\${nodeText.noSymptomCode}`	
25.	<p>Verify in SM155: Hard Drives Matrix that the installed hard drive or flash storage model is compatible with this computer configuration.</p> <p>Is installed HDD or flash storage compatible with this model?</p>	Yes	Go to step 26.	`\${nodeText.yesSymptomCode}`	
		No	Unsupported HDD or Flash Storage installed, or missing/incorrect hard drive thermal sensor. Check with user for out-of-warranty resolution. Verify resolution.	`\${nodeText.noSymptomCode}`	
26.	<p>Identify the type of storage device affected:</p> <ul style="list-style-type: none"> Hard Disk Drive (HDD) Flash Storage <p>Is the affected device an HDD or flash storage?</p>	HDD	Go to step 27.	`\${nodeText.yesSymptomCode}`	
		Flash Storage	Replace the user's flash storage. Verify issue resolved.	H85	SSD
27.	<p>To troubleshoot this issue completely, a known-good hard drive data cable or hard drive combo cable (depending on model) is required.</p> <p>Do you have immediate access to a known-good hard drive data cable or hard drive combo cable?</p>	Yes	Go to step 28.	`\${nodeText.yesSymptomCode}`	
		No	Replace the user's hard drive. Verify issue resolved.	H85	HDD
28.	<p>Substitute a known-good hard drive data cable or hard drive combo cable (depending on model) and retest using MRI.</p> <p>Does computer now pass the THxx sensor check?</p>	Yes	Replace the user's hard drive data cable or hard drive combo cable (depending on model). Verify issue resolved.	X03	INTERNAL CABLE
		No	Reinstall user's hard drive data cable or combo cable (depending on model). Replace the user's hard drive. Verify issue resolved.	H85	HDD
29.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the power supply.</p> <p>Is a power supply thermal sensor failing a test?</p>	Yes	Replace power supply. Verify issue resolved.	P17	POWER SUPPLY
		No	Go to step 30.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
30.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the display.</p> <p>Is a display thermal sensor failing a test?</p>	Yes	Go to step 31.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	
31.	<p>To troubleshoot this issue completely, a known-good display panel is required.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 32.	\${nodeText.yesSymptomCode}	
		No	<p>Replace display panel. Verify issue resolved.</p>	L85	LCD
32.	<p>Substitute a known-good display panel and retest using MRI.</p> <p>Does MRI still report a TL0p or TL1p thermal sensor test failure?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	<p>Replace display panel. Verify issue resolved.</p>	L85	LCD
33.	<p>Use Cooling System Diagnostic to verify that the computer is running within thermal specifications.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

Mechanical, Physical, or Cosmetic Damage

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<p>The computer shows signs of physical or cosmetic damage such as:</p> <ul style="list-style-type: none">• Enclosure and stand:<ul style="list-style-type: none">◦ Stand hinge is loose or broken.◦ Stand is bent, loose, or broken.◦ Screw is stripped, loose, or missing.◦ Scratches.◦ Dents.◦ Cracks.◦ Liquid spill.• Display Assembly:<ul style="list-style-type: none">◦ Broken glass.◦ Cracked display panel.◦ Scratches.◦ Dents.◦ Liquid spill. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Inspect the computer and discuss the nature of the issue with the user. Determine whether the user wants to proceed with the repair (despite possible accidental damage) or pursue other service options. Click “No” to proceed with further troubleshooting.2. Refer to TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac Computers for guidance regarding possible damage to the user’s computer.3. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. <p>Note: For input device issues, including damage, go to the “External Apple Bluetooth Peripherals” or “External Apple Wired Keyboard and Mouse” troubleshooting flows.</p>

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine the cause of damage or defects: user, technician, environment, accidental damage, or abuse.	Yes	ESCALATION REQUIRED. Contact ACS for assistance with Apple-related accidental damage.	X99	
	Is an Apple technician responsible for the damage or defect on the computer?	No	Go to step 2.	\$(nodeText.noSymptomCode}	
2.	Closely examine the user’s computer for signs of enclosure damage, such as: <ul style="list-style-type: none">• Stand hinge is loose or broken.• Screw is stripped, loose, or missing.• Stand is bent, loose, or broken.	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple’s one-year limited warranty or the AppleCare Protection Plan (APP). Refer to www.apple.com/legal/warranty for details.	X12	ENCLOSURE
	Does the computer exhibit this type of damage?	No	Go to step 3.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
3.	<p>Closely examine the user's computer for signs of enclosure damage, such as:</p> <ul style="list-style-type: none"> • Scratches • Dents • Cracks <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	X13	ENCLOSURE
		No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	<p>Closely examine the user's computer enclosure for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's enclosure.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	X90	ENCLOSURE
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
5.	<p>Closely examine the user's computer for signs of display damage, such as a cracked, dented, or broken display frame or assembly housing.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	L18	LCD
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	<p>Closely examine the user's computer display panel for signs of cosmetic damage, such as:</p> <ul style="list-style-type: none"> • Scratches • Dents <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	L19	LCD
		No	Go to step 7.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	<p>Closely examine the user's computer display panel for signs of a single hairline crack.</p> <p>A single hairline crack is one continuous curved or straight crack. It may travel across the whole screen or cover a small area.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	L35	LCD
	Does the computer exhibit this type of damage?	No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	<p>Closely examine the user's computer display panel for signs of multiple cracks.</p> <p>Two or more glass cracks, or two or more hairline cracks, count as multiple cracks.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	L36	LCD
	Does the computer exhibit this type of damage?	No	Go to step 9.	\$(nodeText.noSymptomCode)	
9.	<p>Closely examine the user's computer display panel for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's display panel.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	L90	LCD
	Does the computer exhibit this type of damage?	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for assistance with Apple-related accidental damage.</p>	\$(nodeText.noSymptomCode)	

Noise, Hum, or Vibration

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, DisplayPort cable, hard disk drive (HDD), hard drive data or power or combo cable, display panel, left speaker, logic board, memory, rear enclosure, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Buzzing noise• Rattling noise• Ticking noise• Squeaking noise• Humming noise• High frequency noise• Mechanical vibration <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">1. Work with the user to reproduce the issue and isolate the source of noise. Differentiate whether the noise is coming from the computer or a connected peripheral. Disconnect all third-party peripherals to isolate the source of noise.2. Determine whether the sound is normal or abnormal. Refer to TS3204: Evaluating System noises for more information.3. If the iMac fan runs at full speed after the computer turns on, you may need to reset the iMac's SMC. Refer to HT204463: If the fans in your Mac run at full speed when you turn it on and HT202179: About fans and fan noise in your Apple product for more information. Reset SMC using procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.4. Verify that the vents on the bottom and back of the computer are free of dust and other obstructions that might inhibit proper airflow through the computer.5. Launch Applications > Utilities > Activity Monitor. Determine whether an application or process is consuming a high percentage of CPU bandwidth. CPU-intensive applications can cause fan to run fast in order to maintain proper internal computer temperatures. If needed, quit application or restart the computer to resolve issue. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none">• TP1620: iMac Pro (2017): Power Supply Cover Instructions• TP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Disconnect any peripheral devices, cards, or cables attached to computer.	Yes	Issue resolved. Issue caused by ground loop induced by third-party devices. Advise user to connect all devices to a common power outlet or contact device manufacturer for support.	\$(nodeText.yesSymptomCode)	
	Has noise been eliminated?	No	Go to step 2.	\$(nodeText.noSymptomCode)	
2.	Tilt display to hinge limits to determine whether mechanical noise is generated by hinge mechanism.	Yes	Go to “Stand or Hinge Issues” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Is noise coming from iMac's display hinge?	No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Replace power supply. Verify issue resolved.	P04	POWER SUPPLY
	Remove display panel. Connect computer to AC power and listen carefully around power supply to verify whether it is source of noise. Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed. Is noise coming from iMac's power supply?	No	Go to step 4.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
4.	Shut down computer. If you reinstalled display panel, remove it.	Yes	Issue resolved by removing loose objects inside chin area.	\$(nodeText.yesSymptomCode)	
	Hold computer firmly with both hands and invert computer while gently shaking it, to attempt to dislodge and remove any loose screws or other foreign objects that may have fallen down inside the computer into the chin area.				
	Loose objects in the chin area can cause noise or vibration, especially during audio playback.	No	Go to step 5.	\$(nodeText.noSymptomCode)	
	Briefly retest for noise, hum, or vibration. Has noise been eliminated?				
5.	Shut down computer and let it cool off fully. Check for noise, hum or vibration during startup when computer is cold.	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
	Does issue happen on or after a cold startup?	No	Go to step 12.	\$(nodeText.noSymptomCode)	
6.	An unreadable thermal sensor can cause fan to run excessively. Run Mac Resource Inspector (MRI) to check thermal sensors.	Yes	Go to “Computer Runs Hot” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Does MRI report any thermal sensor failures?	No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	Excessive fan operation may also occur if computer is unable to read fan speed. Check MRI results for fan (motor) sensor test results.	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
	Does MRI report any fan (motor) failures?	No	Go to step 10.	\$(nodeText.noSymptomCode)	
8.	To troubleshoot this issue completely, a known-good fan is required.	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to known-good fan?	No	Replace fan. Verify issue resolved.	X23	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
9.	Substitute known-good fan and retest with MRI. Does known-good fan pass fan (motor) test in MRI?	Yes	Replace fan. Verify issue resolved.	X23	OTHER ELECTRIC
		No	Reinstall user's fan. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M23	MLB
10.	Disconnect fan and briefly retest for noise, hum, or vibration. Has noise been eliminated?	Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
		No	Go to step 12.	\$(nodeText.noSymptomCode)	
11.	Verify whether any tape, gasket, cable label, cable, or other material is touching fan blades and causing a ticking or buzzing noise. Secure material so it does not touch fan blades. If tape adhesive has lost its stickiness, replace that section of tape. Remove fan and rotate blades. Verify that fan blades spin smoothly without interference from fan housing, cables, tape, gaskets or other components. Reinstall fan while carefully ensuring that there are no cables routed under or near fan assembly that might cause interference with fan blades. After reassembling computer, verify whether noise issue is resolved. Has noise been eliminated?	Yes	Issue resolved by securing internal components or material to prevent touching fan blades. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	Replace fan. Verify issue resolved.	X23	OTHER ELECTRIC
12.	Depending on configuration, there may or may not be a hard drive installed. Other configurations may have either a flash storage card or both flash storage and HDD. Is a hard drive installed in computer?	Yes	Go to step 13.	\$(nodeText.yesSymptomCode)	
		No	Go to step 14.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	Remove internal hard drive.	Yes	Go to “HDD Noisy” troubleshooting flow.	\${nodeText.yesSymptomCode}	
	Use one of the following two methods to start up the computer to a known-good macOS.				
	Start up the computer to Internet Recovery. See HT201314: About macOS Recovery .	No	Go to step 14.	\${nodeText.noSymptomCode}	
	Start up the computer to a known-good external macOS startup volume.				
14.	Has noise been eliminated?	Yes	Go to “Distorted Audio from Internal Speakers” troubleshooting flow.	\${nodeText.yesSymptomCode}	
	Play sound sample at loud and soft volume levels to determine whether noise is caused by left or right speakers or amplifier circuit. Plug in external headphones to identify whether noise comes from audio out or from other source. Mute computer volume. Verify whether issue still occurs.				
	Has noise been eliminated?	No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	To troubleshoot this issue completely, a known-good fan is required.	Yes	Go to step 16.	\${nodeText.yesSymptomCode}	
		No	Go to step 17.	\${nodeText.noSymptomCode}	
	Do you have immediate access to a known-good fan?				
16.	Substitute known-good fan and retest.	Yes	Replace fan. Verify issue resolved.	X23	OTHER ELECTRIC
		No	Go to step 18.	\${nodeText.noSymptomCode}	
	Has noise been eliminated?				
17.	Disconnect fan and briefly retest for noise, hum, or vibration.	Yes	Replace fan. Verify issue resolved.	X23	OTHER ELECTRIC
		No	Go to step 18.	\${nodeText.noSymptomCode}	
	Has noise been eliminated?				

	Check	Result	Action	Code	Commodity
18.	With hard drive and fan disconnected, briefly retest once again while listening closely for any noise, hum, or vibration coming from logic board and heat sink assembly.	Yes	Replace the logic board.	M24	MLB
	Inspect logic board and heat sink assembly for any damage that may have occurred during removal or replacement.		Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.		
	Logic board and heat sink assembly must be treated as a single unit during removal or replacement. All screws must be removed from both components prior to physically pulling or pushing either component.		Verify that the issue is resolved.		
	Any mishandling of heat sink assembly that is attached to logic board can cause damage to heat pipes connecting these components.	No	Go to step 19.	\${nodeText.noSymptomCode}	
	If heat pipes become even slightly damaged (bent or kinked for example), normal heat removal cycle can become disrupted, causing a repetitive hammering noise from this area. Damage may not be visibly noticeable.				
	Noise may be mistaken for a faulty hard drive. Check for this noise with hard drive and fan disconnected.				
	Is there noise coming from logic board and heat sink assembly?	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
19.	Noise may be related to interference from other electrical devices operating near computer or plugged into same power outlet. See whether noise is eliminated when computer runs in a different location on a different circuit.				
	Has noise been eliminated?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

	Check	Result	Action	Code	Commodity
20.	Confirm that the computer's noise, hum, or vibration has been eliminated.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	<p>If help is needed, record a sample audio file to review with ACS.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

Stand or Hinge Issues

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Bent standBroken hingeStripped screw headStripped screw boss or threadsLoose stand or hinge <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Inspect the computer and discuss the nature of issue with the user. Determine whether the user wants to proceed with repair (despite possible accidental damage) or pursue other service options.Click “No” to proceed with further troubleshooting. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to articles:</p> <ul style="list-style-type: none">TP833: iMac and Displays: Power Supply Cover InstructionsTP820: iMac (27-inch): SafetyTP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to articles:</p> <ul style="list-style-type: none">TP1620: iMac Pro (2017): Power Supply Cover InstructionsTP1637: iMac Pro (2017): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine cause of damage or defects: user/technician, environment, accidental damage, or abuse.	Yes	ESCALATION REQUIRED. Contact ACS for assistance with Apple-related accidental damage.	X99	
	Is an Apple agent responsible for damage or defect on the computer?	No	Go to step 2.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
2.	<p>Inspect stand to determine whether it requires replacement.</p> <p>Verify that stand securely holds computer in its upright position without wobbling when placed on a hard, smooth, even surface.</p> <p>Is stand damaged or defective?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Replace stand. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	X99	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	<p>Inspect hinge mechanism to determine whether it requires replacement.</p> <p>Adjust computer back and forth on its hinge, listening for hinge noise. Check feel of the hinge. Its movement should feel firm—not tight or loose—as it holds the iMac in position. Hinge should operate smoothly along its entire travel.</p> <p>Is hinge mechanism damaged or defective?</p>	Yes	<p>Replace hinge mechanism. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p>	X12	PIECE PART
		No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	<p>Place the customer's iMac on a solid, flat surface.</p> <p>Have another person apply downward pressure to the stand to hold it down on that solid surface.</p> <p>Firmly grasp both sides of the iMac enclosure, and gently attempt to rotate the entire enclosure left and right while facing the display. The enclosure should not be able to move in this direction.</p> <p>Compare this behavior with a known-good, similar iMac model.</p> <p>If the enclosure rotates an abnormal amount, the mechanism mounts inside the rear enclosure may no longer be securely attached, which may require a rear enclosure replacement.</p> <p>Does the iMac's enclosure rotate an abnormal amount?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Replace the rear enclosure. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	X99	
		No	Go to step 5.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	Place the user's iMac on a solid, flat surface and check if one side of the display appears to sit higher or lower than the other side.	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
	Does one side of the iMac appear to sit higher or lower than the other side?	No	Go to step 6.	`\${nodeText.noSymptomCode}`	
6.	Verify that both stand and hinge operate properly and that they securely hold the iMac upright in all appropriate positions. Is the issue resolved?	Yes	Issue resolved.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Intermittent Shutdown

Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, DisplayPort cable, left speaker, memory, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antennas, wireless card

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Shuts down during startup• Shuts down unexpectedly during use• Computer restarts spontaneously• Turns off when waking from sleep <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">1. Run AST or AST 2 Mac Resource Inspector diagnostic suite (MRI) to verify correct operation of sensors and fan.2. Check for and apply latest software and firmware updates.3. Inspect fan performance during operation to make sure fan is spinning. Check that vents are not blocked, and if necessary, use compressed air to remove dust or debris from rear fan exhaust.4. Compare computer's operating temperature to a known-good, similarly configured computer.5. Check for runaway applications using the information in HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity. Follow the instructions to halt any processes that are using excessive system resources.6. Hold down the Shift key during startup to put the computer into safe mode. Refer to HT201262: Use safe mode to isolate issues with your Mac.7. Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.8. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.9. Reset SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.10. Verify that computer's internal hard drive or flash storage is an Apple-installed part. Compare hard drive information in System Information to the Apple Hard Drives Matrix in SM155: Hard Drives Matrix to determine whether user's installed drive is one of OEM drives available for this computer configuration. Third-party hard drives without correct firmware or thermal sensors, or outside this computer's specifications, may cause computer to run hot or permanently activate fan at full speed. In such cases, inform user that computer has been modified from its original, supported configuration, and that such a repair would not be covered under Apple warranty. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p>

	<p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP833: iMac and Displays: Power Supply Cover Instructions • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> • TP1620: iMac Pro (2017): Power Supply Cover Instructions • TP1637: iMac Pro (2017): Safety
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Deep Dive

	Check	Result	Action	Code	Commodity
1.	Power and thermal issues can cause intermittent shutdowns. Run AST or AST 2 Mac Resource Inspector diagnostic suite (MRI) to check for problems detected by sensors.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	Sensors that indicate they are out of normal operating range or an inoperative fan can cause intermittent shutdowns.	No	Go to step 5.	`\${nodeText.noSymptomCode}`	
	Does computer pass all MRI checks?				
2.	Start up from internal drive and attempt to reproduce shutdown symptom(s).	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	Can you reproduce shutdown event?	No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
3.	<p>Connect a known-good Apple wired keyboard and Apple wired mouse to user's computer.</p> <p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Does shutdown issue persist?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M08	MLB
		No	<p>Repair disk directory using Disk Utility. If the issue persists after repair, refer to HT201260: Find out which macOS your Mac is using and install the correct macOS version and build on user's hard drive. Check for and apply latest software and firmware updates. Verify issue resolved.</p>	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
4.	Run AST or AST 2 extended memory test suite, if available, repeatedly to verify that the computer does not unexpectedly shut down. Did computer shut down unexpectedly?	Yes	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M08	MLB
		No	No failure found during repeated diagnostic testing. Using correct positioning, return computer to user with no trouble found. Verify that the issue is resolved.	\${nodeText.noSymptomCode}	
5.	Determine specific type of failure reported in diagnostics: thermal/fan sensor or voltage/current sensor. <ul style="list-style-type: none"> • MRI thermal sensors begin with Txxx. • MRI electrical voltage sensors begin with Vxxx. • MRI electrical current sensors begin with Ixxx. Which sensor failure does diagnostics report?	Voltage/Current Sensor	Go to step 6.	\${nodeText.yesSymptomCode}	
		Thermal/Fan Sensor	Go to step 12.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
6.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel.</p> <p>Some power-related sensors are located in power supply, but are read through a SMBus connection to logic board.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Does MRI report a VDxx or IDxx test failure?</p>	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
		No/Other	Go to step 10.	`\${nodeText.noSymptomCode}`	
7.	<p>Reseat DC power cable connection to logic board. Reassemble and retest, using MRI.</p> <p>Does MRI still report a VDxx or IDxx sensor test failure?</p>	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
		No	Issue resolved by reseating DC power cable connection between power supply and logic board. Verify resolution.	`\${nodeText.noSymptomCode}`	
8.	<p>To troubleshoot this issue completely, a known-good power supply is required.</p> <p>Do you have immediate access to a known-good power supply?</p>	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	<p>DC power cable is part of power supply.</p> <p>Replace power supply.</p> <p>Verify that the issue is resolved.</p>	P02	POWER SUPPLY

	Check	Result	Action	Code	Commodity
9.	<p>Substitute a known-good power supply, reassemble and retest using MRI.</p> <p>Does MRI still report a VDxx or IDxx sensor test failure?</p>	Yes	<p>Reinstall user's power supply.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M08	MLB
		No	<p>DC power cable is part of power supply.</p> <p>Replace power supply.</p> <p>Verify that the issue is resolved.</p>	P02	POWER SUPPLY
10.	<p>Most voltage and current regulators are located on logic board. To troubleshoot this issue completely, a known-good logic board is required.</p> <p>Do you have immediate access to a known-good logic board?</p>	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M08	MLB

	Check	Result	Action	Code	Commodity
11.	Substitute a known-good logic board, reassemble and retest using MRI. Does MRI still report a Vxxx or lxxxx sensor test failure?	Yes	Reinstall user's logic board. Replace power supply. Verify issue resolved.	P02	POWER SUPPLY
		No	Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M08	MLB
12.	Identify specific type of failure reported in MRI: thermal sensor or fan (motor) error. MRI thermal sensors begin with Txxx. Which sensor failure does diagnostics report?	Fan (Motor)	Go to step 13.	`\${nodeText.yesSymptomCode}`	
		Thermal	Go to step 19.	`\${nodeText.noSymptomCode}`	
13.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding. Remove display panel. Refer to the service guide Functional Overview to locate affected fan connection to logic board. Disconnect fan cable connectors and inspect logic board and fan cable connector pins for damage. Is there any cable or connector damage on fan or logic board?	Yes	Go to step 14.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 16.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
14.	<p>Identify whether fan, logic board, or both are damaged.</p> <p>Are both fan and logic board damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	<p>Identify whether fan or logic board is damaged.</p> <p>Which part is damaged?</p>	Fan	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
		Logic Board	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
16.	<p>Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseal fan cable connections to logic board. Reassemble and retest with MRI.</p> <p>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</p> <p>Does computer pass fan motor check?</p>	Yes	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	Go to step 17.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
17.	To troubleshoot this issue completely, a known-good fan is required.	Yes	Go to step 18.	\${nodeText.yesSymptomCode}	
	Do you have immediate access to a known-good fan?	No	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
18.	Substitute a known-good fan, and retest using MRI. Does computer now pass fan motor check?	Yes	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
		No	Reinstall user's fan. Replace the logic board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M08	MLB
19.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding. Remove display panel. Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseal fan cable connections to logic board. Reassemble and retest with MRI. Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed. Does MRI still report a Txxx thermal sensor test failure?	Yes	Go to step 20.	\${nodeText.yesSymptomCode}	
		No	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
20.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the logic board.</p> <p>Refer to service documentation for thermal sensor information and locations.</p> <p>Is a logic board thermal sensor failing a test?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M23	MLB
		No	Go to step 21.	\$_{nodeText.noSymptomCode}\$	
21.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the Hard Disk Drive (HDD) or Flash Storage.</p> <p>Note: Some models do not have a HDD.</p> <p>Is a hard drive or flash storage thermal sensor failing a test?</p>	Yes	Go to step 22.	\$_{nodeText.yesSymptomCode}\$	
		No	Go to step 26.	\$_{nodeText.noSymptomCode}\$	
22.	<p>Verify in SM155: Hard Drives Matrix that the installed hard drive or flash storage model is compatible with this computer configuration.</p> <p>Is installed HDD or flash storage compatible with this model?</p>	Yes	Go to step 23.	\$_{nodeText.yesSymptomCode}\$	
		No	Unsupported HDD or Flash Storage installed, or missing/incorrect hard drive thermal sensor. Check with user for out-of-warranty resolution. Verify resolution.	\$_{nodeText.noSymptomCode}\$	
23.	<p>Identify the type of storage device affected:</p> <ul style="list-style-type: none"> Hard Disk Drive (HDD) Flash Storage <p>Is the affected device an HDD or flash storage?</p>	HDD	Go to step 24.	\$_{nodeText.yesSymptomCode}\$	
		Flash Storage	Replace the user's flash storage. Verify issue resolved.	H85	SSD

	Check	Result	Action	Code	Commodity
24.	To troubleshoot this issue completely, a known-good hard drive data cable or hard drive combo cable (depending on model) is required. Do you have immediate access to a known-good hard drive data cable or hard drive combo cable?	Yes	Go to step 25.	`\${nodeText.yesSymptomCode}`	
		No	Replace the user's hard drive. Verify issue resolved.	H85	HDD
25.	Substitute a known-good hard drive data cable or hard drive combo cable (depending on model) and retest using MRI. Does computer now pass the THxx sensor check?	Yes	Replace the user's hard drive data cable or hard drive combo cable (depending on model). Verify issue resolved.	X03	INTERNAL CABLE
		No	Reinstall user's hard drive data cable or combo cable (depending on model). Replace the user's hard drive. Verify issue resolved.	H85	HDD
26.	Identify whether a thermal sensor that is currently failing MRI test is related to the power supply. Is a power supply thermal sensor failing a test?	Yes	Replace power supply. Verify issue resolved.	P02	POWER SUPPLY
		No	Go to step 27.	`\${nodeText.noSymptomCode}`	
27.	Identify whether a thermal sensor that is currently failing MRI test is related to the display. Is a display thermal sensor failing a test?	Yes	Go to step 28.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M99	
28.	To troubleshoot this issue completely, a known-good display panel is required. Do you have immediate access to a known-good display panel?	Yes	Go to step 29.	`\${nodeText.yesSymptomCode}`	
		No	Replace display panel. Verify issue resolved.	L85	LCD

	Check	Result	Action	Code	Commodity
29.	Substitute a known-good display panel and retest using MRI. Does MRI still report a TL0p or TL1p thermal sensor test failure?	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	\${nodeText.yesSymptomCode}	
		No	Replace display panel. Verify issue resolved.	L85	LCD
30.	Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Verify that the issue is resolved. Is the issue resolved?	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M99	

Kernel Panic or System Instability

Unlikely causes:

Battery, DisplayPort cable, hard drive power or combo cable, display panel, left speaker, power supply, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antenna(s)

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Computer displays a kernel panic alert message• Computer freezes during use• Computer freezes upon wake from sleep• Computer freezes when Wi-Fi is enabled or activated <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">1. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.2. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates. Remember that third-party software can contribute to this issue. It may be necessary to check for and apply third-party updates that may not appear in the App store.3. Remove all external devices, except for a known-good USB keyboard and mouse, to help rule out peripherals as a possible cause of this issue.4. Verify memory configuration matches actual amount of installed physical memory.5. Hold Shift key during startup to put computer into safe mode. See HT201262: Use safe mode to isolate issues with your Mac.6. Follow steps outlined in HT200553: If your Mac spontaneously restarts or displays a message that it restarted or shut down because of a problem.7. If the issue cannot be easily reproduced, Run AST or AST 2 extended memory tests, if available, repeatedly, to verify that the computer does not encounter a crash or kernel panic.8. If the computer model is internally equipped with both a hard disk drive (HDD) and a solid-state drive (SSD), refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes. <p>Warning: Be extremely careful when working inside the computer when power is applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">• TP833: iMac and Displays: Power Supply Cover Instructions• TP820: iMac (27-inch): Safety• TP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	A voltage, current, or thermal sensor failure or an inoperative fan can cause kernel panics or system crashes. Run Macintosh Resource Inspector (MRI) or consult MRI logs to check for any sensor or fan failures. Does MRI report any sensor or fan failures?	Yes	Go to “Intermittent Shutdown” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
		No	Go to step 2.	\$(nodeText.noSymptomCode)	
2.	Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac Then reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac . Does computer still experience crashes or kernel panics?	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	Issue resolved by SMC/NVRAM reset. Verify resolution. This issue could reoccur if the cause is one of the user's external devices that was not brought in with the computer. Advise user to verify computer is functioning properly by initially leaving all external devices detached, then connecting them one at a time to confirm each device's functionality. If this issue reoccurs, the user should document which external devices are attached and bring them with the computer.	\$(nodeText.noSymptomCode)	
3.	Ask user which USB device(s) are used with computer when crashes or kernel panics occur. Does user have a USB device that may be causing crashes or kernel panics?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
4.	Connect a known-good Apple wired keyboard and Apple wired mouse to user's computer. Disconnect user's USB device(s). Test computer with OS or diagnostics. Does computer still experience crashes or kernel panics?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	ESCALATION REQUIRED. Contact ACS for additional support and latest USB device information.	X99	

	Check	Result	Action	Code	Commodity
5.	Connect a known-good Apple wired keyboard and Apple wired mouse to user's computer.	Yes	Go to step 6.	\$(nodeText.yesSymptomCode}	
	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to Internet Recovery. See HT201314: About macOS Recovery.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>If the computer model is internally equipped with both a hard disk drive (HDD) and a solid-state drive (SSD), refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes.</p> <p>Does computer still experience crashes or kernel panics?</p>	No	Go to step 28.	\$(nodeText.noSymptomCode}	
6.	Hold Shift key during startup to put computer into Safe Mode. See HT201262: Use safe mode to isolate issues with your Mac .	Yes	Go to step 7.	\$(nodeText.yesSymptomCode}	
	Does computer still experience crashes or kernel panics?	No	Go to step 11.	\$(nodeText.noSymptomCode}	
7.	On some models the memory is non-serviceable and can not be removed from the MLB.	Yes	Go to step 9.	\$(nodeText.yesSymptomCode}	
	Is the memory removable from the system?	No	Go to step 8.	\$(nodeText.noSymptomCode}	
8.	Check to see if diagnostic LED #3 is illuminated.	Yes	Go to step 11.	\$(nodeText.yesSymptomCode}	
	<p>Note: Depending on computer model, this may simply require looking through the bottom air flow opening or removing the display panel.</p> <p>Is diagnostic LED #3 illuminated?</p>	No	Replace logic board. Verify issue resolved.	M06	MLB

	Check	Result	Action	Code	Commodity
9.	<p>Remove installed memory modules and substitute one by one with a known-good memory module.</p> <p>Note: Depending on computer model, this may simply require removal of the rear door, or the removal of display panel and logic board to access the memory modules.</p> <p>Does computer still experience crashes or kernel panics?</p>	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
		No	<p>Isolate and replace memory module.</p> <p>Note: Only replace a defective memory module. There is no need to replace memory in pairs.</p> <p>Verify issue resolved.</p>	X01	MEMORY
10.	<p>Check logic board memory slots one by one, using a known-good memory module, to isolate a slot-related failure and retest.</p> <p>Note: Connecting an external display will permit retesting without reinstalling the internal display panel.</p> <p>Does crash or kernel panic occur when memory is installed in a specific slot?</p>	Yes	<p>Replace logic board.</p> <p>Reinstall user's memory.</p> <p>Verify issue resolved.</p>	M06	MLB
		No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
11.	<p>Note: The wireless card is part of the logic board and is not removable in some models. If so, then reply “Yes” to skip this step and continue troubleshooting.</p> <p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove wireless card and retest by testing computer with OS or diagnostics. Connect power cord to computer, wait five seconds for SMC to reset, then press power button.</p> <p>Warning: Be extremely careful when working inside the computer while power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>Does computer still experience crashes or kernel panics?</p>	Yes	Go to step 17.	\$(nodeText.yesSymptomCode}	
		No	Go to step 12.	\$(nodeText.noSymptomCode}	
12.	<p>Inspect wireless card and logic board connectors for damage.</p> <p>Did you find any damaged components?</p>	Yes	Go to step 16.	\$(nodeText.yesSymptomCode}	
		No	Go to step 13.	\$(nodeText.noSymptomCode}	
13.	<p>Reseat wireless card to logic board and retest with OS or diagnostics.</p> <p>Does computer still experience crashes or kernel panics?</p>	Yes	Go to step 14.	\$(nodeText.yesSymptomCode}	
		No	<p>Run AST or AST 2 extended memory tests, if available, repeatedly to verify that the computer does not encounter a crash or kernel panic.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
14.	To troubleshoot this issue completely, a known-good wireless card is required.	Yes	Go to step 15.	\$(nodeText.yesSymptomCode}	
	Do you have immediate access to a known-good wireless card?	No	Replace wireless card. Verify issue resolved.	N13	WIRELESS DEVICE
15.	Substitute a known-good wireless card and retest computer with OS or diagnostics.	Yes	Replace logic board. Reinstall user's wireless card. Verify issue resolved.	M06	MLB
	Does computer still experience crashes or kernel panics?	No	Replace wireless card. Verify issue resolved.	N13	WIRELESS DEVICE
16.	Identify whether wireless card is the only damaged component. Damage to multiple parts will require an escalation to ACS.	Yes	Replace wireless card. Verify issue resolved.	N13	WIRELESS DEVICE
	Is damaged limited to wireless card only?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
17.	Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.	Yes	Go to step 25.	\$(nodeText.yesSymptomCode}	
	Disconnect camera/microphone/ALS cable or camera cable (depending on model) from either logic board or camera and retest computer with OS or diagnostics. Does computer still experience crashes or kernel panics?	No	Go to step 18.	\$(nodeText.noSymptomCode}	
18.	Inspect camera, camera/microphone/ALS cable or camera cable, and logic board connector for damage.	Yes	Go to step 24.	\$(nodeText.yesSymptomCode}	
	Did you find any damaged components?	No	Go to step 19.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
19.	Reseat both ends of camera/microphone/ALS cable or camera cable and retest computer with OS or diagnostics. Does computer still experience crashes or kernel panics?	Yes	Go to step 20.	\$(nodeText.yesSymptomCode)	
		No	Run AST or AST 2 extended memory tests, if available, repeatedly to verify that the computer does not encounter a crash or kernel panic. Verify that the issue is resolved.	\$(nodeText.noSymptomCode)	
20.	To troubleshoot this issue completely, a known-good camera/microphone/ALS Cable or camera cable (depending on model) is required. Do you have immediate access to a known-good camera cable?	Yes	Go to step 21.	\$(nodeText.yesSymptomCode)	
		No	Replace camera/microphone/ALS Cable or camera cable (depending on model). Verify that the issue is resolved.	X03	INTERNAL CABLE
21.	Substitute a known-good camera/microphone/ALS cable or camera cable and retest computer with OS or diagnostics. Does computer still experience crashes or kernel panics?	Yes	Go to step 22.	\$(nodeText.yesSymptomCode)	
		No	Replace camera/microphone/ALS Cable or camera cable (depending on model). Verify that the issue is resolved.	X03	INTERNAL CABLE
22.	To troubleshoot this issue completely, a known-good camera is required. Do you have immediate access to a known-good camera?	Yes	Go to step 23.	\$(nodeText.yesSymptomCode)	
		No	Replace camera. Reinstall user's camera/microphone/ALS cable or camera cable. Verify issue resolved.	X11	OTHER ELECTRIC
23.	Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components. Substitute a known-good camera and retest computer with OS or diagnostics. Does computer still experience crashes or kernel panics?	Yes	Replace logic board. Reinstall user's camera and camera/microphone/ALS or camera cable. Verify issue resolved.	M06	MLB
		No	Replace camera. Reinstall user's camera/microphone/ALS cable or camera cable. Verify issue resolved.	X11	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
24.	Identify whether camera/microphone/ALS cable or camera cable is the only damaged component. Damage to multiple parts will require an escalation to ACS.	Yes	Replace camera/microphone/ALS Cable or camera cable (depending on model). Verify that the issue is resolved.	X03	INTERNAL CABLE
	Is damaged limited to camera/microphone/ALS cable or camera cable only?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
25.	Mac models may have a hard drive, SSD or flash storage, or both. If the iMac is internally equipped with both, refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes.	Yes	Go to step 36.	\${nodeText.yesSymptomCode}	
	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Disconnect hard drive data cable (or SSD or flash storage) from logic board. Connect an Ethernet cable and power cord to computer, wait five seconds for SMC to reset, then press power button. Hold down Command-Option-R keys during startup to force restart from macOS Internet recovery.</p> <p>This process may take a few minutes for computer to completely start up, depending on speed of your Internet connection. See HT201314: About macOS Recovery for more information.</p> <p>Does computer still experience crashes or kernel panics?</p>	No	Go to step 26.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
26.	<p>Mac models may have a hard drive, SSD or flash storage, or both. If the iMac is internally equipped with both, refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes. To support Fusion Drive functionality, a known-good HDD and SSD or flash storage should be used.</p> <p>To completely troubleshoot this issue, the following known-good parts are required:</p> <ul style="list-style-type: none"> • Hard drive or SSD or flash storage • Hard drive data cable or combo cable (depending on model) <p>For a Fusion Drive computer, the following known-good parts are required:</p> <ul style="list-style-type: none"> • Hard drive and paired SSD or flash storage • Hard drive data cable or combo cable (depending on model) <p>Do you have immediate access to each of these known-good parts?</p>	Yes	Go to step 30.	\$(nodeText.yesSymptomCode}	
		No	Go to step 27.	\$(nodeText.noSymptomCode}	
27.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Reconnect hard drive data cable (or SSD or flash storage) to logic board.</p> <p>Hold down Command-R during startup to restart from the recovery partition and use Disk Utility to repair user's hard drive or SSD or flash storage. If disk repair is successful, restart and test user's OS.</p> <p>Was Disk Utility repair successful and is kernel panic issue resolved?</p>	Yes	Issue resolved after Disk Utility repair. Verify resolution.	\$(nodeText.yesSymptomCode}	
		No	Go to step 28.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
28.	Reinstall macOS on the user's computer.	Yes	Go to step 29.	\$(nodeText.yesSymptomCode}	
	Check for and apply the latest software and firmware updates. Does computer still experience crashes or kernel panics?	No	Issue resolved after reinstalling macOS. Verify resolution.	\$(nodeText.noSymptomCode}	
29.	Identify the type of storage device affected: <ul style="list-style-type: none"> Hard disk drive (HDD) Flash storage or solid-state drive (SSD) 	HDD	Replace the user's hard drive. Verify issue resolved.	H02	HDD
	Is the affected device an HDD or SSD?	SSD	Replace the user's SSD or flash storage. Verify issue resolved.	H02	SSD
30.	iMacs equipped with both a hard disc drive (HDD) and solid-state drive (SSD) / flash storage ship as a Fusion Drive configuration. Refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes.	Yes	Go to step 35.	\$(nodeText.yesSymptomCode}	
	Is computer configured as a Fusion Drive?	No	Go to step 31.	\$(nodeText.noSymptomCode}	
31.	iMac may be equipped with either a hard drive or SSD or flash storage. Identify which type of storage device is installed.	Hard Drive	Go to step 33.	\$(nodeText.yesSymptomCode}	
	Is computer equipped with a hard drive or with a SSD or flash storage card?	SSD/Flash Storage	Go to step 32.	\$(nodeText.noSymptomCode}	
32.	Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.	Yes	Replace logic board. Reinstall user's SSD or flash storage. Verify issue resolved.	M06	MLB
	Substitute known-good SSD or flash storage with an up-to-date, bootable version of macOS installed. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Does computer still experience crashes or kernel panics?	No	Replace user's SSD or flash storage. Verify issue resolved.	H02	SSD

	Check	Result	Action	Code	Commodity
33.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good hard drive with an up-to-date, bootable version of macOS installed. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model.</p> <p>Does computer still experience crashes or kernel panics?</p>	Yes	Go to step 34.	\$(nodeText.yesSymptomCode)	
		No	Replace user's hard drive. Verify issue resolved.	H02	HDD
34.	<p>Continue using known-good hard drive. Substitute a known-good hard drive data cable or combo cable (depending on model) between drive and logic board, and retest computer with OS.</p> <p>Does computer still experience crashes or kernel panics?</p>	Yes	Replace logic board. Reinstall user's hard drive (and SSD or flash storage if so equipped). Also reinstall user's data cable or combo cable. Verify issue resolved.	M06	MLB
		No	Replace hard drive data cable or combo cable (depending on model). Reinstall user's hard drive. Verify issue resolved.	X03	OTHER ELECTRIC
35.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good hard drive and SSD or flash storage paired as a Fusion Drive with an up-to-date, bootable version of macOS installed. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model.</p> <p>Does computer still experience crashes or kernel panics?</p>	Yes	Go to step 34.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

	Check	Result	Action	Code	Commodity
36.	Use extended version of Cooling System Diagnostics (CSD) to verify proper function of the following subsystems: <ul style="list-style-type: none"> SMC Fan Thermal sensors CPU–heat sink thermal interface 	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
	Does computer pass all CSD checks?	No	Go to step 37.	\$(nodeText.noSymptomCode)	
37.	Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components. Inspect fan and heat sink fin stack. Partial disassembly of computer is required to access fan and heat sink. Use an ESD-safe vacuum to remove any dust or debris. Reassemble and retest using CSD.	Yes	Issue resolved by cleaning airflow. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Does computer pass all CSD checks?	No	Go to step 38.	\$(nodeText.noSymptomCode)	
38.	To troubleshoot this issue completely, a known-good fan is required.	Yes	Go to step 39.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to known-good fan?	No	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
39.	Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components. Substitute a known-good fan and retest using CSD.	Yes	Replace fan. Verify issue resolved.	X22	OTHER ELECTRIC
	Does computer now pass CSD tests?	No	Go to step 40.	\$(nodeText.noSymptomCode)	
40.	To troubleshoot this issue completely, a known-good logic board is required.	Yes	Go to step 41.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to a known-good logic board?	No	Reinstall user's fan. Replace logic board. Verify issue resolved.	M18	MLB

	Check	Result	Action	Code	Commodity
41.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Continue to use known-good fan. Substitute a known-good logic board. Reassemble computer and retest with MRI and CSD.</p> <p>Do both known-good fan and logic board pass MRI and CSD tests?</p>	Yes	Reinstall user's fan. Replace logic board. Verify issue resolved.	M18	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
42.	<p>Run AST or AST 2 extended memory tests, if available, repeatedly to verify that the computer does not encounter a crash or kernel panic.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

No Power

Unlikely causes:

Camera, camera/microphone/ALS cable or camera cable, CPU fan, DisplayPort cable, hard disk drive (HDD), HDD data or power or combo cable, display panel, left speaker, memory, right speaker, solid-state drive (SSD)/Flash storage card, stand, Wi-Fi/Bluetooth antenna(s)

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer does not turn onComputer does not turn offNo image on internal or external displaysNo startup sound (not available on some models)No sounds from fan or hard drive (if hard drive present)No Caps Lock LED when key is pressed on wired keyboardNon-operational <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">Verify AC power source.Disconnect all peripherals.Verify user's power cord.Determine whether computer is in power-on state by checking for all of the following:<ul style="list-style-type: none">Caps Lock LED on wired keyboardFan spinning soundStartup sound (not available on some models)Hard drive spin (if hard drive present)Display backlight onAny display activityThunderbolt disk mode operationFollow suggested steps in HT204267: If your Mac doesn't turn on or start up.Reset SMC using the procedure listed in HT201295: How to reset the System Management Controller (SMC) on your Mac. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none">TP833: iMac and Displays: Power Supply Cover InstructionsTP820: iMac (27-inch): SafetyTP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	The user may report that the computer will not turn off or the computer will not turn on (no power). Which issue is the user experiencing?	Will Not Turn Off	Go to step 22.	\$(nodeText.yesSymptomCode)	
		No Power	Go to step 2.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
2.	Press power button to start up computer. Check computer for any signs of power activity, such as fan or hard drive activity (if hard drive present), startup sound (not available on some models), or Caps Lock LED on wired keyboard. Does computer show any signs of power activity?	Yes	Go to step 16.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Inspect user's power cord for wire or connector damage. Also inspect computer AC inlet for signs of arcing or damaged pins, which could affect power cord connections. Did you find any damaged components?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
4.	Determine whether damage affects user's power cord, AC inlet, or both. Is damage limited to power cord only?	Yes	Replace user's power cord. Verify issue resolved.	X03	EXTERNAL CABLE
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
5.	Verify that user's power cord is securely plugged into a known-good, grounded electrical outlet that provides adequate voltage and power to operate computer. Ensure power cord is fully seated to AC inlet. Attempt to turn on computer. Does issue persist after reseating power cord?	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	Go to step 16.	\$(nodeText.noSymptomCode)	
6.	Substitute a known-good power cord and attempt to turn on computer. Does issue persist with known-good power cord?	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Replace user's power cord. Verify issue resolved.	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
7.	Reset SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
	<ol style="list-style-type: none"> 1. Press and hold power button a little more than 10 seconds to force SMC to turn off computer from an unknown power state. 2. Disconnect power cord and wait 15 seconds with power cord removed to reset SMC. 3. Attach computer's power cord, making sure power button is not being pressed. 4. Wait five seconds, then press power button to turn on computer. <p>Does issue persist after SMC reset?</p>	No	Issue resolved after SMC reset. Verify resolution.	\$(nodeText.noSymptomCode)	
8.	Remove AC power cord and allow time for power supply to discharge before opening computer for repair.	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
	<p>Remove display panel to inspect and reseal:</p> <ul style="list-style-type: none"> • AC inlet power to power supply • DC power cable between power supply and logic board • Power button cable to power supply <p>Inspect wires and connectors, looking for pinched or exposed wire, and burnt or damaged connectors and pins.</p> <p>Did you find any damaged components?</p>	No	Go to step 10.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	<p>Determine whether damage affects DC power cable only, or additional components such as power supply or logic board connectors. Multiple damaged parts requiring replacement will be escalated to ACS.</p> <p>Is damage limited to DC power cable only?</p>	Yes	<p>DC power cable is part of power supply.</p> <p>Replace power supply.</p> <p>Verify that the issue is resolved.</p>	P16	POWER SUPPLY
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	P99	
10.	<p>Connect power cord to computer, wait five seconds for SMC to set, then press power button. Check computer for any signs of power activity, such as fan or hard drive activity (if hard drive present), startup sound (not available on some models), or Caps Lock LED on wired keyboard.</p> <p>Warning: Be extremely careful when working inside the computer while power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>Does computer show any signs of power activity?</p>	Yes	Go to step 16.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
11.	Disconnect the wireless card from the logic board.	Yes	Replace wireless card. Verify issue resolved.	N01	WIRELESS DEVICE
	<p>Note: The wireless card is part of the logic board and is not removable in some models. If so, then reply “No” to skip this step and continue troubleshooting.</p> <p>Attempt normal startup.</p>	No	Go to step 12.	\${nodeText.noSymptomCode}	
	<p>Check computer for any signs of power activity, such as fan or hard drive activity (if hard drive present), startup sound (not available on some models), or Caps Lock LED on wired keyboard.</p> <p>Does computer show any signs of power activity?</p>				
12.	Locate diagnostic LEDs on logic board. With AC power cord connected to computer, verify whether diagnostic LED #1 is on, indicating power supply is providing power to SMC and logic board.	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
	<p>Warning: Be extremely careful when working inside the computer while power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>Is diagnostic LED #1 on?</p>	No	Replace power supply. Verify issue resolved.	P01	POWER SUPPLY

	Check	Result	Action	Code	Commodity
	<p>Important: This step requires multimeter test probes with a very fine point in order to reach the conductive portion or the power button connector. Do not request a replacement enclosure unless you are using the correct multimeter probes when testing the power button.</p> <p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding and allow the power supply and logic board to discharge.</p> <p>Disconnect power button cable from logic board to inspect cable and connector for damage. Using a multimeter set as ohm meter, verify continuity between the two pins of the power button when it is pressed.</p>	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
13.	<p>A properly working power button should be open (disconnected) when the button is released and closed (connected) when the button is pressed.</p> <p>A meter reading of 0 to 0.2 Ω (ohms) means that the power button has continuity (the button is closed or connected).</p> <p>A meter reading of 0.2 Ω (ohms) to ∞ (infinity) means that the power button does not have continuity (the button is open or disconnected).</p> <p>For additional information on using a multimeter, see HT3250: Using a digital multimeter.</p> <p>Does power button have continuity when button is pressed and open when released?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Replace the rear enclosure which includes the power button and cable. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty.</p> <p>Contact ACS for additional support regarding warranty coverage for this part.</p>	X14	

	Check	Result	Action	Code	Commodity
14.	Reconnect power button cable to power supply. Connect power cord to computer, wait five seconds for SMC to set, then press power button to start up computer. Verify whether diagnostic LED #2 is on soon after power button is pressed. This indicates that power to start up computer is on.	Yes	Go to step 15.	\$(nodeText.yesSymptomCode)	
	Warning: Be extremely careful when working inside the computer while power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.	No	Replace power supply. Verify issue resolved.	P01	POWER SUPPLY
	Are both diagnostic LED #1 and LED #2 on?				
15.	Check computer for any signs of power activity, such as fan or hard drive activity (if hard drive present), startup sound (not available on some models), or Caps Lock LED on wired keyboard.	Yes	Go to step 16.	\$(nodeText.yesSymptomCode)	
	Does computer show any signs of power activity?	No	Go to step 18.	\$(nodeText.noSymptomCode)	
16.	Verify whether a video signal appears on display.	Yes	Run Mac Resource Inspector (MRI) to obtain latest test results. Verify issue resolved.	\$(nodeText.yesSymptomCode)	
	Is a video image clearly visible on display?	No	Go to step 17.	\$(nodeText.noSymptomCode)	
17.	On a display with dim or no backlight, shine a bright flashlight onto front of display while carefully checking for a faint image showing graphics, an Apple logo, open windows, or other signs that the system is partially functional.	Yes	Go to “Backlight Issues or No Backlight” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Is any video visible with flashlight?	No	Go to “Power But No Video” troubleshooting flow.	\$(nodeText.noSymptomCode)	
18.	To continue to troubleshoot this issue, a known-good power supply is required.	Yes	Go to step 19.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to a known-good power supply?	No	Go to step 20.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
19.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur.</p> <p>Substitute a known-good power supply and attempt to turn on computer.</p> <p>Does computer show any signs of power activity?</p>	Yes	Replace power supply. Verify issue resolved.	P01	POWER SUPPLY
		No	Go to step 20.	\$(nodeText.noSymptomCode)	
20.	<p>Measure the logic board coin battery voltage.</p> <p>Refer to the service guide 'Diagnostic LEDs and Test Pads' for information about locating the RTC battery measurement test pads.</p> <p>Carefully touch one multimeter probe to each pad to measure an expected coin battery voltage of 3 volts DC.</p> <p>If the voltage is 2.7 VDC or less, replace the coin battery.</p> <p>For additional information on using a multimeter, see HT3250: Using a digital multimeter.</p> <p>Is the coin battery voltage low (2.7 VDC or less)?</p>	Yes	<p>Replace coin cell battery.</p> <p>Note: Effective immediately, some coin cell batteries used on Mac systems are now available only from electronics parts distributors (for example, MCM). The coin battery is no longer available to order via GSX. Please order this battery from an electronics parts distributor.</p> <p>Note: BR2032 and CR2032 batteries have the same form factor and nominal voltage. However, BR2032 batteries have a lower self-discharge rate and broader operating temperature range than CR2032 batteries for longer shelf and service life.</p> <p>Verify that the issue is resolved.</p>	X32	OTHER ELECTRIC
		No	Go to step 21.	\$(nodeText.noSymptomCode)	
	<p>Important: Remove AC power to computer and wait two minutes.</p> <p>Force-reset the logic board Real-Time Clock (RTC) using one of the procedures listed below, and refer to corresponding link for exact location of reset pads for this computer. Be extra careful not to touch any other components to avoid damaging logic board.</p> <p>Warning: Do not short-circuit the reset pads for more than a few seconds, as doing so may cause damage to coin battery and/or logic board.</p> <p>1. Small flat-blade screwdriver: Gently touch flat edge of the tip of the blade to both pads simultaneously.</p> <p>2. Torx T-10 screwdriver: Holding screwdriver vertically,</p>	Yes	Issue resolved by resetting logic board. Verify resolution.	\$(nodeText.yesSymptomCode)	

21.	<p>bridge the flat surface of the tip across both reset pads.</p> <p>3. Two small metal jeweler's screwdrivers: Touch the tip of each screwdriver to each reset pad, then cross the shanks of the two screwdrivers and touch them together briefly.</p> <p>Refer to the service guide 'Diagnostic LEDs and Test Pads' for information about locating the RTC reset test pads.</p> <p>Connect power cord to computer, wait five seconds for SMC to set, then press power button. Check computer for any signs of power activity, such as fan or hard drive activity (if hard drive present), startup sound (not available on some models), or Caps Lock LED on wired keyboard.</p> <p>Warning: Be extremely careful when working inside the computer while power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>Does computer show any signs of power activity?</p>	No	Replace logic board. Verify issue resolved.	M01	MLB
22.	<p>If any app hangs or freezes when the computer is shutting down, then try to force quit that app. Also check if any software updates are in progress.</p> <p>Does the computer turn off?</p>	Yes	Issue resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	Go to step 23.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
23.	Press and hold down the power button for 10 seconds or until user's computer powers off. Does the computer turn off?	Yes	Go to step 24.	\$(nodeText.yesSymptomCode}	
		No	Go to step 25.	\$(nodeText.noSymptomCode}	
24.	Reset SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac . 1. Press and hold power button a little more than 10 seconds to force SMC to turn off computer from an unknown power state. 2. Disconnect power cord and wait 15 seconds with power cord removed to reset SMC. 3. Attach computer's power cord, making sure power button is not being pressed. 4. Wait five seconds, then press power button to turn on computer. Does issue persist after SMC reset?	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	P99	
		No	Issue resolved after SMC reset. Verify resolution.	\$(nodeText.noSymptomCode}	
25.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding. Remove display panel to inspect and reseal: <ul style="list-style-type: none"> AC inlet power to power supply DC power cable between power supply and logic board Power button cable to power supply Inspect wires and connectors, looking for pinched or exposed wire, and burnt or damaged connectors and pins. Did you find any damaged components?	Yes	Go to step 26.	\$(nodeText.yesSymptomCode}	
		No	Go to step 27.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
26.	Determine whether damage affects power button cable only from main logic board to rear enclosure, or additional components such as power supply or logic board connectors. Multiple damaged parts requiring replacement will be escalated to ACS.	Yes	Replace the rear enclosure which includes the power button and cable. Verify that the issue is resolved.	X03	ENCLOSURE
	Is damage limited to power button cable only?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	P99	
27.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	No failure found during diagnostic testing. Using correct positioning, return computer to user with no trouble found. Verify issue resolved.	\$(nodeText.yesSymptomCode)	
	Disconnect power button cable from power supply to inspect cable and connector for damage. Using a multimeter set to read ohms, verify continuity between the two pins of the power button when it is pressed. A properly working power button should be open when button is released. For additional information on using a multimeter, see HT3250: Using a digital multimeter . Does power button have continuity when button is pressed and open when released?	No	ESCALATION REQUIRED. Replace the rear enclosure which includes the power button and cable. Verify issue resolved. Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to www.apple.com/legal/warranty . Contact ACS for additional support regarding warranty coverage for this part.	X14	
28.	Verify that computer can now complete startup process over multiple trials.	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
	Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Verify that the issue is resolved. Is the issue resolved?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Will Not Start Up

Unlikely causes:

Camera, camera/microphone/ALS cable or camera cable, CPU fan, DisplayPort cable, left speaker, power supply, rear enclosure, right speaker, stand

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> No startup sound (not available on some models) or POST (Power-On Self-Test) Black or gray screen with backlight Some video activity, Apple logo, progress bar Prohibitory sign or folder with flashing question mark Audible fan, hard drive spin (if present), or optical drive reset sounds (if present) Error beep tones Caps Lock key light toggles on and off when Caps Lock key pressed <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> Use macOS Recovery to troubleshoot potential software issues. Press and hold Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates. Remember that third-party software can contribute to this issue. It may be necessary to check for and apply third-party updates that may not appear in the App Store. Verify that startup process passes initial memory checks and POST (Power-On Self-Test) with a normal startup sound (not available on some models) and some video activity. If computer generates beeping sounds, there may be an issue with memory. See HT201702: About Mac Power On Self Test (POST) RAM error codes. Try to determine what the computer was doing during startup. Refer to HT204156: About the screens your Mac displays as it starts up. Follow suggested steps in HT204267: If your Mac doesn't turn on or start up and HT201150: How to turn your Mac on or off. Follow suggested steps in HT204463: If the fans in your Mac run at full speed when you turn it on. Hold down the Shift key during startup to put the computer into safe mode. Refer to HT201262: Use safe mode to isolate issues with your Mac. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac. Start up from Mac Resource Inspector diagnostic suite (MRI), check for the presence of an installed macOS, then refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model. Run Disk Utility or check Mac Resource Inspector (MRI) results to verify presence and SMART status of user's hard drive (HDD) or solid-state drive (SSD)/flash storage card. iMac models may have a hard drive or SSD/flash storage card, or both. If the computer model is internally equipped with both a hard disk drive (HDD) and a solid-state drive (SSD), refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes. <p>Warning: Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, be sure to turn off computer, and unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> TP833: iMac and Displays: Power Supply Cover Instructions TP820: iMac (27-inch): Safety TP914: iMac (21.5-inch): Safety

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Verify that computer completes full startup process: Startup sound (not available on some models) > gray screen > Apple logo > spinning gear > login screen > user's desktop.	Yes	Issue cannot be duplicated.	\$(nodeText.yesSymptomCode)	
	Does computer complete startup process to user's desktop?	No	Go to step 2.	\$(nodeText.noSymptomCode)	
2.	Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac .	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
	<p>A memory error is indicated by a sequence of one or three beep tones. Refer to HT201702: About Mac Power On Self Test (POST) RAM error codes for more information.</p> <p>Check whether computer has a memory error (a series of beep tones during startup).</p> <p>Does computer make error beep tones at startup?</p>	No	Go to step 18.	\$(nodeText.noSymptomCode)	
3.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Go to step 18.	\$(nodeText.yesSymptomCode)	
	<p>Remove display panel.</p> <p>Check to see if diagnostic LED #3 is illuminated.</p> <p>Warning: Be extremely careful when working inside the computer while power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>Is the diagnostic LED #3 illuminated?</p>	No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	Reseat all memory modules securely in their slots and retest.	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
	Does computer make error beep tones at startup?	No	Issue resolved. Verify resolution.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	Some iMac models have four memory slots and may have up to four memory modules to test. Does this computer have four memory slots?	Yes	Go to step 9.	\$(nodeText.yesSymptomCode}	
		No	Go to step 6.	\$(nodeText.noSymptomCode}	
6.	Remove logic board to access memory slots. Remove user's memory module from the first slot and substitute a known-good memory module into same slot. Reinstall logic board and display panel (without VHB foam layers) and retest. Does computer indicate a memory error with one known-good module and one user module?	Yes	Go to step 7.	\$(nodeText.yesSymptomCode}	
		No	Replace defective memory. Note: You may not return non-Apple memory as KBB. Please verify Apple memory using MRI before returning to Apple. Verify issue resolved.	X02	MEMORY
7.	Keep known-good memory module in the first slot and substitute second slot module with a second known-good memory module. Retest. Does computer indicate a memory error using two known-good memory modules?	Yes	Replace logic board. Verify issue resolved.	M07	MLB
		No	Go to step 8.	\$(nodeText.noSymptomCode}	
8.	Install first user memory module in first memory slot and test with a known-good memory module in second slot. Does computer indicate a memory error?	Yes	Replace both memory modules. Note: You may not return non-Apple memory as KBB. Please verify Apple memory using MRI before returning to Apple. Verify issue resolved.	X02	MEMORY
		No	Replace defective memory. Note: You may not return non-Apple memory as KBB. Please verify Apple memory using MRI before returning to Apple. Verify issue resolved.	X02	MEMORY

	Check	Result	Action	Code	Commodity
9.	<p>Typical configurations ship with two memory modules located in first two slots. It is possible to see a configuration with four memory modules installed.</p> <p>Is user's computer configured with four memory modules installed?</p>	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
		No	Go to step 15.	\$(nodeText.noSymptomCode)	
10.	<p>Keep track of where memory is located as you work in pairs to isolate memory and later verify slot functionality. Remove user memory from second two slots and retest.</p> <p>Does computer indicate a memory error with user memory in first two slots only?</p>	Yes	Go to step 15.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
11.	<p>Leave user memory installed in first two slots. Install two known-good memory modules in second two slots and retest.</p> <p>Does computer indicate a memory error with known-good memory in second two slots?</p>	Yes	Replace logic board. Verify issue resolved.	M07	MLB
		No	Go to step 12.	\$(nodeText.noSymptomCode)	
12.	<p>Leave the two installed known-good memory modules in second two slots. Remove user memory from first two slots and set aside as proven good user memory. Install user memory originally removed from second two slots and place this memory into proven good first two slots. Retest.</p> <p>Does computer indicate a memory error with user memory in first two slots?</p>	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
		No	Go to step 13.	\$(nodeText.noSymptomCode)	
13.	<p>Remove known-good memory from second two slots, leaving user memory (originally from second two slots) in first two slots. Install previously proven good user memory (originally from first two slots) into second two slots. Restart computer to verify user memory that has been reversed from original first two and second two slot configuration.</p> <p>Does computer indicate a memory error with user memory?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support.</p> <p>Situation - user memory passes test when paired with known-good memory but fails when paired with like user memory.</p>	M99	
		No	Issue resolved with memory reconfiguration, memory/slot reseal. Verify resolution.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
14.	<p>Remove known-good memory from second two slots, leaving user memory in first two slots. Restart computer to verify user memory in first two slots as standalone with no memory in second two slots.</p> <p>Does computer indicate a memory error with user memory in first two slots only?</p>	Yes	Go to step 15.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support.</p> <p>Situation: User memory (currently located first two slots) fails when paired with known-good memory and passes when known-good memory is removed from adjacent slots.</p>	M99	
15.	<p>Remove user memory module from first slot and substitute a known-good memory module into same first slot. Retest.</p> <p>Does computer indicate a memory error with one known-good and one user module in first two slots?</p>	Yes	Go to step 16.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace defective memory.</p> <p>Note: You may not return non-Apple memory as KBB. Please verify Apple memory using MRI before returning to Apple.</p> <p>Verify issue resolved.</p>	X02	MEMORY
16.	<p>Keep known-good memory module in first slot and substitute second slot module with a second known-good memory module. Keep track of suspect user memory removed from second slot. Testing both first two slots with known-good memory will verify error is either defective slots or defective memory.</p> <p>Does computer indicate a memory error using two known-good memory modules in first two slots?</p>	Yes	Replace logic board. Verify issue resolved.	M07	MLB
		No	Go to step 17.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
17.	Install first user memory module (removed from first slot) into second memory slot and test paired with a known-good memory module still in first slot.	Yes	Replace both user memory modules in first two slots. Note: You may not return non-Apple memory as KBB. Please verify Apple memory using MRI before returning to Apple. Verify issue resolved.	X02	MEMORY
	Does computer indicate a memory error?	No	Replace defective memory. Note: You may not return non-Apple memory as KBB. Please verify Apple memory using MRI before returning to Apple. Verify issue resolved.	X02	MEMORY
18.	Observe startup process to verify computer gets to initial gray screen after startup sound.	Yes	Go to step 19.	\$(nodeText.yesSymptomCode)	
	Does computer reach a gray screen during startup process?	No	Go to "Power But No Video" troubleshooting flow.	\$(nodeText.noSymptomCode)	
19.	Start up computer and determine whether a kernel panic is occurring.	Yes	Go to "Kernel Panic or System Instability" troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Does computer display a kernel panic during startup?	No	Go to step 20.	\$(nodeText.noSymptomCode)	
20.	Connect a known-good Apple wired keyboard and Apple wired mouse to user's computer.	Yes	Go to step 21.	\$(nodeText.yesSymptomCode)	
	Use one of the following two methods to start up the computer to a known-good macOS. Start up the computer to Internet Recovery. See HT201314: About macOS Recovery . Start up the computer to a known-good external macOS startup volume. Does computer start up from known-good macOS?	No	Go to step 24.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
21.	<p>Use a Fusion Drive-capable version of Disk Utility, AST or AST 2 Mac Resource Inspector (MRI) suite, or Storage Diagnostic suite to determine whether the user's HDD, SSD, or flash storage is recognized, and SMART status is verified.</p> <p>Is user's HDD, SSD, or flash storage detected and SMART status verified?</p>	Yes	Go to step 22.	\$(nodeText.yesSymptomCode)	
		No	Go to “HDD, SSD, or Flash Storage Not Recognized, Not Mounting, or Read/Write Issues” troubleshooting flow.	\$(nodeText.noSymptomCode)	
22.	<p>If the computer model is internally equipped with both a hard disk drive (HDD) and a solid-state drive (SSD), refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes.</p> <p>Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model.</p> <p>Is correct version and build of macOS installed on user's HDD, SSD, or flash storage?</p>	Yes	Go to step 23.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	
23.	<p>Run Disk Utility from the recovery partition to repair the user's HDD, SSD, or flash storage. Attempt to start up from the user's HDD, SSD, or flash storage.</p> <p>Does computer start up successfully from user's HDD, SSD, or flash storage?</p>	Yes	<p>Issue resolved.</p> <p>Verify resolution.</p>	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
24.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur.</p> <p>Disconnect hard drive power and data cables (or hard drive combo cable, depending on model) at the hard drive. Remove SSD/flash storage card, if present. In order to verify the startup process with the display panel removed, connect an external display.</p> <p>Connect power cord to computer, wait five seconds for SMC to reset, then press power button. Hold down Command-Option-R keys during startup to force restart from macOS Internet Recovery over NetBoot. See HT201314: About macOS Recovery.</p> <p>Warning: Be extremely careful when working inside the computer while power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> • TP820: iMac (27-inch): Safety • TP914: iMac (21.5-inch): Safety <p>Does computer start up from macOS Internet Recovery?</p>	Yes	Go to step 25.	\$(nodeText.yesSymptomCode)	
		No	Go to step 37.	\$(nodeText.noSymptomCode)	
25.	<p>To troubleshoot this issue completely, a known-good HDD, SSD, or flash storage (depending on computer configuration) is required.</p> <p>Do you have immediate access to a known-good HDD, SSD, or flash storage?</p>	Yes	Go to step 26.	\$(nodeText.yesSymptomCode)	
		No	Go to step 29.	\$(nodeText.noSymptomCode)	
26.	<p>Substitute known-good HDD, SSD, or flash storage. Refer to HT201260: Find out which macOS your Mac is using to make sure system build is correct for this computer model.</p> <p>Does computer start up with known-good HDD, SSD, or flash storage?</p>	Yes	Go to step 27.	\$(nodeText.yesSymptomCode)	
		No	Go to step 29.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
27.	<p>If the computer model is internally equipped with both a hard disk drive (HDD) and a solid-state drive (SSD), refer to HT202574: About Fusion Drive, a storage option for some Mac computers for specific troubleshooting and restore processes.</p> <p>Is user's computer configured with a Fusion Drive?</p>	Yes	Go to step 29.	\${nodeText.yesSymptomCode}	
		No	Go to step 28.	\${nodeText.noSymptomCode}	
28.	<p>Identify the type of storage device affected:</p> <ul style="list-style-type: none"> • Hard disk drive (HDD) • Flash storage/solid-state drive (SSD) <p>Is the affected device an HDD or SSD?</p>	HDD	Replace the user's hard drive. Verify issue resolved.	H02	HDD
		SSD	Replace the user's flash storage/SSD. Verify issue resolved.	H02	SSD
29.	<p>Reseat and inspect hard drive power cable or hard drive combo cable (depending on model). Look for damaged wires, and pin or connector housing damage.</p> <p>Did you find any damaged components?</p>	Yes	Go to step 31.	\${nodeText.yesSymptomCode}	
		No	Go to step 30.	\${nodeText.noSymptomCode}	
30.	<p>Identify the type of storage device affected:</p> <ul style="list-style-type: none"> • Hard disk drive (HDD) • Flash storage/solid-state drive (SSD) <p>Is the affected device an HDD or SSD?</p>	HDD	Go to step 32.	\${nodeText.yesSymptomCode}	
		SSD	Go to step 35.	\${nodeText.noSymptomCode}	
31.	<p>Multiple-component damage requires an escalation to ACS for multipart replacement.</p> <p>Is damage limited to hard drive power cable or hard drive combo cable only?</p>	Yes	<p>Replace hard drive power cable or hard drive combo cable (depending on model). Reinstall user's hard drive. Verify issue resolved.</p>	X03	INTERNAL CABLE
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

	Check	Result	Action	Code	Commodity
32.	<p>With hard drive power cable or hard drive combo cable reseated, turn on computer and verify hard drive disc spins up.</p> <p>Does hard drive seem to be spinning as expected?</p>	Yes	Go to step 33.	\$(nodeText.yesSymptomCode)	
		No	Replace hard drive power cable or hard drive combo cable (depending on model). Reinstall user's hard drive. Verify issue resolved.	X03	INTERNAL CABLE
33.	<p>To troubleshoot this issue completely, a known-good hard drive data cable or hard drive combo cable (depending on model) is required.</p> <p>Do you have immediate access to a known-good hard drive data cable or hard drive combo cable?</p>	Yes	Go to step 34.	\$(nodeText.yesSymptomCode)	
		No	Replace the user's hard drive. Verify issue resolved.	H02	HDD
34.	<p>Substitute a a known-good hard drive data cable or hard drive combo cable (depending on model) and retest.</p> <p>Does computer start up with known-good hard drive data cable or hard drive combo cable?</p>	Yes	Replace the user's hard drive data cable or hard drive combo cable (depending on model). Reinstall user's hard drive. Verify issue resolved.	X03	INTERNAL CABLE
		No	Go to step 35.	\$(nodeText.noSymptomCode)	
35.	<p>At this point in the troubleshooting process, you may be using the user's HDD, SSD, or flash storage or a known-good HDD, SSD, or flash storage.</p> <p>A. User's HDD, SSD, or flash storage B. Known-Good HDD, SSD, or flash storage</p> <p>Which storage device type is currently installed?</p>	A	Go to step 36.	\$(nodeText.yesSymptomCode)	
		B	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	
36.	<p>Identify the type of storage device affected:</p> <ul style="list-style-type: none"> • Hard disk drive (HDD) • Flash storage or solid-state drive (SSD) <p>Is the affected device an HDD or SSD?</p>	HDD	Replace the user's hard drive. Reinstall user's hard drive data cable or hard drive combo cable. Verify issue resolved.	H02	HDD
		SSD	Replace the user's flash storage/SSD. Verify issue resolved.	H02	SSD

	Check	Result	Action	Code	Commodity
37.	<p>Note: The wireless card is part of the logic board and is not removable in some models. If so, then reply “No” to skip this step and continue troubleshooting.</p> <p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove wireless card from logic board. Reconnect hard drive power and data cables (or hard drive combo cable, depending on model) to the hard drive. Reconnect SSD/flash storage card, if present.</p> <p>Connect power cord to computer, wait five seconds for SMC to become ready, then press power button. Use Startup Manager or hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.</p> <p>Does computer start up from recovery partition?</p>	Yes	Go to step 38.	\$(nodeText.yesSymptomCode)	
		No	Go to step 43.	\$(nodeText.noSymptomCode)	
38.	<p>Inspect wireless card edge connector on logic board for bent pins or housing damage.</p> <p>Is logic board connector damaged?</p>	Yes	Replace logic board. Verify issue resolved.	M24	MLB
		No	Go to step 39.	\$(nodeText.noSymptomCode)	
39.	<p>Inspect wireless card for damage. Verify clean contact on card edge connector, no soot from electrical short, no broken antenna connections, proper heat transfer pad attached, and a flat surface overall. Confirm no bending or broken printed circuit board or EMI shield.</p> <p>Is wireless card damaged?</p>	Yes	Replace the wireless card. Verify issue resolved.	N17	WIRELESS DEVICE
		No	Go to step 40.	\$(nodeText.noSymptomCode)	
40.	<p>Reseat wireless card connection to logic board.</p> <p>Use Startup Manager or hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.</p> <p>Does computer start up from recovery partition?</p>	Yes	Issue resolved by reseating wireless card. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	Go to step 41.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
41.	To troubleshoot this issue completely, a known-good wireless card is required.	Yes	Go to step 42.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to a known-good wireless card?	No	Replace wireless card. Verify issue resolved.	N13	WIRELESS DEVICE
42.	Substitute a known-good wireless card.	Yes	Replace wireless card. Verify issue resolved.	N13	WIRELESS DEVICE
	Use Startup Manager or hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery . Verify that Wi-Fi is present. Does computer start up from recovery partition?	No	Replace logic board. Reinstall user's wireless card. Verify issue resolved.	M02	MLB
43.	<p>Important: Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur.</p> <p>Measure the logic board coin battery voltage.</p> <p>Refer to the service guide 'Diagnostic LEDs and Test Pads' for information about locating the RTC battery measurement test pads.</p> <p>Carefully touch one multimeter probe to each pad to measure an expected coin battery voltage of 3 volts DC. If the voltage is 2.7 VDC or less, replace the coin battery.</p> <p>For additional information on using a multimeter, see HT3250: Using a digital multimeter.</p> <p>Is the coin battery voltage low (2.7 VDC or less)?</p>	Yes	<p>Replace coin cell battery.</p> <p>Note: Effective immediately, some coin cell batteries used on Mac systems are now available only from electronics parts distributors (for example, MCM). The coin battery is no longer available to order via GSX. Please order this battery from an electronics parts distributor.</p> <p>Note: BR2032 and CR2032 batteries have the same form factor and nominal voltage. However, BR2032 batteries have a lower self-discharge rate and broader operating temperature range than CR2032 batteries for longer shelf and service life.</p> <p>Verify that the issue is resolved.</p>	X32	OTHER ELECTRIC
		No	Go to step 44.	\$(nodeText.noSymptomCode)	
	<p>Important: Remove AC power to computer and wait two minutes.</p> <p>Force-reset the logic board Real-Time Clock (RTC) using one of</p>	Yes	Issue resolved by resetting the logic board. Verify resolution.	\$(nodeText.yesSymptomCode)	

	Check	Result	Action	Code	Commodity
		No	Replace logic board. Verify issue resolved.	M02	MLB

	Check	Result	Action	Code	Commodity
45.	Verify that computer can now complete startup process over multiple trials.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	<p>Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

About Apple service certifications

Topic

To learn more about accessing [ATLAS](#) and service exams, review these articles:

- [How to get a Tech ID](#)
- [ATLAS frequently asked questions](#)
- [How to access Apple service exams at Pearson VUE](#)
- Certifications Explained Video - ([SV370](#)) for AASPs, ([SV371](#)) for Apple Store employees.

Note: Apple Store employees must read [Understanding Exam and Certification requirements](#) (RS228), in addition to this procedure.

Exams and courses that you need to service iOS products

Training for Apple Certified iOS Technician (ACiT) 2019 is available to technicians who work at Apple-authorized service facilities. Technicians need a Global Service Exchange (GSX) account to see the courses in [ATLAS](#).

To register for any ACiT exam, use [Pearson VUE](#).

ACiT 2019 Certification

With ACiT 2019 certification, you can service iOS devices such as iPhone and iPad, released before March 15, 2019, after passing the following exams:

- Apple Service Fundamentals Exam (SVC-19A)
- ACiT 2019 iOS Service Certification Exam (iOS-19A)

Please note that the following devices have additional requirements:

- iPad Air (3rd generation), iPad mini (5th generation):
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS

ACiT 2018 certification

Important: If you are not already ACiT 2018 certified, complete the ACiT 2019 exam instead.

With ACiT 2018 certification, you can service iOS devices such as iPhone and iPad released before April 2018 after passing the following exams:

- Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A)
- ACiT 2018 iOS Service Certification Exam (iOS-18A)

Please note that the following devices have additional requirements:

- iPad Air (3rd generation), iPad mini (5th generation), iPad Pro 12.9-inch (3rd generation), iPad Pro 11.0-inch
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone XR:
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.
- iPhone XS and iPhone XS Max:
 - Also complete the iPhone XS and iPhone XS Max Product Qualification ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.

ACiT 2017 certification

Important: If you are not already ACiT 2017 certified, complete the ACiT 2019 exam instead.

With ACiT 2017 certification, you can service iPhone, iPad, Apple Watch and Apple TV devices released before April 2017 after passing the following exams:

- Apple Service Fundamentals Exam (SVC-17A)
- ACiT 2017 iOS Service Certification Exam (iOS-17A)

Please note that the following devices have additional product qualification requirements:

- iPad Air (3rd generation), iPad mini (5th generation), iPad Pro 12.9-inch (3rd generation), iPad Pro 12.9-inch (2nd Generation), iPad Pro 12.9-inch, iPad Pro 11.0-inch, iPad Pro 10.5-inch, iPad

- Pro 9.7-inch, iPad (6th Generation), iPad (5th Generation) and iPad mini 4
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone XR
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS
- iPhone XS and iPhone XS Max
 - Also complete the iPhone XS and iPhone XS Max Product Qualifications ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS
- iPhone X
 - Also complete the iPhone X Product Qualification course ([PQ-040](#)) in ATLAS
- iPhone 8 and iPhone 8 Plus
 - Also complete the iPhone 8 and 8 Plus Product Qualification course ([PQ-036](#)) in ATLAS.

ACiT 2016 certification

Important: If you are not already ACiT 2016 certified, complete the ACiT 2019 exam instead.

With ACiT 2016 certification, you can service iPhone, iPad, Apple Watch and Apple TV devices released before April 2016 after passing these exams:

- Apple Service Fundamentals Exam (SVC-16A)
- ACiT 2016 iOS Service Certification Exam (iOS-16A)

Please note that the following devices have additional product qualification requirements:

- iPad Air (3rd generation), iPad mini (5th generation), iPad Pro 12.9-inch (3rd generation), iPad Pro 12.9-inch (2nd generation), iPad Pro 12.9-inch, iPad Pro 11.0-inch, iPad Pro 10.5-inch, iPad Pro 9.7-inch, iPad (6th generation), iPad (5th generation), and iPad mini 4
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone XR:
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS
- iPhone XS and iPhone XS Max
 - Also complete the iPhone XS and iPhone XS Max Product Qualification ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS
- iPhone X
 - Also complete the iPhone X Product Qualifications course ([PQ-040](#)) in ATLAS
- iPhone 8 and 8 Plus
 - Also complete the iPhone 8 and 8 Plus Product Qualification course ([PQ-036](#)) in ATLAS
- iPhone 7 and 7 Plus
 - Also complete the iPhone 7 and iPhone 7 Plus Product Qualification course ([9L0-PQ20](#)) in ATLAS.

Exams and courses that you need to service Mac products

Training for Apple Certified Mac Technician (ACMT) 2019 is available to technicians who work at Apple-authorized service facilities. Technicians need a Global Service Exchange (GSX) account to view the courses in [ATLAS](#). To register for any ACMT exam, use [Pearson VUE](#).

ACMT 2019 certification

With ACMT certification, you can service Mac computers released before March 15, 2019 after passing these exams:

- Apple Service Fundamentals Exam (SVC-19A)
- ACMT 2019 Mac Service Certification Exam (MAC-19A)

Please note that the following devices have additional product qualification requirements:

- MacBook Pro (15-inch, 2019)
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2019, Four Thunderbolt 3 ports)
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- iMac (2019)
 - Also complete the iMac 2019 Models Product Qualification course ([PQ-056](#)) in ATLAS.

ACMT 2018 certification

Important: If you're not already ACMT 2018 certified, complete the ACMT 2019 exams instead.

With ACMT 2018 certification, you can service Mac computers released before April 2018 after passing these exams:

- Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A)
- ACMT 2018 Mac Service Certification Exam (MAC-18A)

These computers have additional product qualification requirements:

- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and Apple T2 Security Chip courses series in ATLAS.
- MacBook Pro (15-inch, 2019)
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2019, Four Thunderbolt 3 ports)
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS
- iMac (2019)
 - Also complete the iMac (2019) Models Product Qualification course ([PQ-056](#)) in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and Apple T2 Security Chip course series in ATLAS.

ACMT 2017 certification

Important: If you're not already ACMT 2017 certified, complete the ACMT 2019 exams instead.

With ACMT 2017 certification, you can service most Mac computers released before April 2017 after passing these exams:

- Apple Service Fundamentals Exam (SVC-17A)
- ACMT 2017 Mac Service Certification Exam (MAC-17A)

These computers have additional product qualification requirements:

- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- MacBook Pro (15-inch, 2019)
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2019, Four Thunderbolt 3 ports):
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS

- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- iMac (2019):
 - Also complete the iMac (2019) Models Product Qualification course ([PQ-056](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) and Apple T2 Security Chip course series in ATLAS.
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and Apple T2 Security Chip course series in ATLAS.

ACMT 2016 certification

Important: If you're not already ACMT 2016 certified, complete the ACMT 2019 exams instead.

With ACMT 2016 certification, you can service most Mac computers released before April 2016 after passing these exams:

- Apple Service Fundamentals Exam (SVC-16A)
- ACMT 2016 Mac Service Certification Exam (MAC-16A)

These computers have additional requirements:

- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and And Apple T2 Security Chip course series in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- MacBook Pro (15-inch, 2019):
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- iMac (2019):
 - Also complete the iMac (2019) Models Product Qualification course ([PQ-056](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) and Apple T2 Security Chip course series in ATLAS
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and Apple T2

ACMT 2015 certification

Important: If you're not already ACMT 2015 certified, complete the ACMT 2019 exams and courses instead.

With ACMT 2015 certification, you can service many Mac computers (some have additional requirements) if you passed these exams:

- OS X Yosemite Troubleshooting Exam (9L0-066)
- Mac Hardware Service Exam (9L0-012)

These computers have additional requirements:

- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook (Retina, 12-inch, Early 2015):
 - Also complete the MacBook (Retina, 12-inch, Early 2015) ([9L0-PQ14](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- MacBook Pro (15-inch, 2019)
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, 15-inch, Mid 2015):
 - Also complete the MacBook Pro 15-inch (2012 to 2015) ([9L0-PQ34](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports)
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, 13-inch, Early 2015):
 - Also complete the MacBook Pro 13-inch (2012 to 2015) course ([9L0-PQ33](#)) in ATLAS.
- iMac (2019):
 - Also complete the iMac (2019) Models Product Qualification course ([PQ-056](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) and Apple T2 Security Chip course series in ATLAS
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and Apple T2 Security Chip course series in ATLAS.

ACMT certification

Important: If you're not already ACMT certified, complete the ACMT 2019 exams and courses instead.

With ACMT certification, you can service most Mac computers released before April 2014 after passing these exams:

- Mac OS X Mavericks Troubleshooting Exam (9L0-065)
- Mac Hardware Service Exam (9L0-011)

These computers have additional requirements. (Some of these exams and courses are not currently available.)

- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook (Retina, 12-inch, Early 2015):
 - Also complete the MacBook (Retina, 12-inch, Early 2015) ([9L0-PQ14](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- MacBook Pro (15-inch, 2019):
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification course ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2019) Product Qualification ([PQ-044](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Pro (Retina, Mid 2012) and MacBook Pro (Retina, 15-inch, Early 2013 to Mid 2014):
 - Also complete the MacBook Pro 15-inch (2012 to 2015) ([9L0-PQ34](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports) Product Qualification ([PQ-043](#)) and Apple T2 Security Chip course series in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Pro (Retina, 13-inch, Late 2012 to Early 2015):
 - Also complete the MacBook Pro 13-inch (2012 to 2015) course ([9L0-PQ33](#)) in ATLAS.
- iMac (2019):
 - Also complete the iMac (2019) Models Product Qualification course ([PQ-056](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) and Apple T2 Security Chip course series in ATLAS.
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS.
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- iMac (Late 2012 to Mid 2015 models):
 - Also complete the iMac (2012 to 2015) course ([9L0-PQ3](#)) in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product Qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) or Apple T2

About the Apple Service Fundamentals Exam (SVC-19A)

The Apple Service Fundamentals Exam (SVC-19A) is a computer-based knowledge test that Pearson VUE offers online. The test is open resource and test takers should use Apple references and courses in ATLAS to help answer the exam items.

Successful completion of this exam fulfills the prerequisite for Apple Certified iOS Technician (ACiT) 2019 certification and Apple Certified Mac Technician (ACMT) 2019 certification. The SVC-19A exam must be successfully completed before taking the Mac or iOS certification exams.

Exam summary

- Number of sections: 5
- Number of learning objectives: 34
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Two separately scored sections must be passed

The exam has two separately-scored sections. Each must be passed to pass the entire exam. This is in addition to the overall passing score listed above. They are:

- ESD Precautions (at least 10 out of the 12 to pass)
- Safety (at least 10 out of 12 to pass)

Sections and topics

Here are the sections and topics covered in Apple Service Fundamentals Exam:

Customer Experience (23 items)

- Identify the probing skills that result in getting good information from the customer
- Select good examples of reflecting and summarizing the customer's answers in order to come to agreement on the issue
- Identify ways to properly position a repair so that the customer knows why it is necessary and is in agreement with the strategy
- Identify ways to position and recommend upgrades and attachments as part of an alternative service strategy.
- Demonstrate use of the "Positive No" in a series of choose-the-phrase exercises
- List practical applications of the four cornerstones of adult learning
- Describe the effect of both complex technical language and over-simplified language
- Identify good examples of phrases to help set accurate customer expectations
- Describe the role of empathy in customer satisfaction
- Identify ways to avoid conflict by using genuine empathy
- Identify causes for conflict in an interaction
- Identify the five-step anger diffusion technique given a customer scenario
- Assess and explain the impact of non-verbal communication

ESD Precautions (12 items)

- Correctly identify and practice ESD precautions
- Correctly identify the components of an ESD-compliant workstation
- Use the proper tools, equipment, and procedures to configure a workspace that minimizes or eliminates the occurrence of electrostatic discharge damage
- Correctly identify the effects of ESD damage on an integrated circuit
- Correctly identify common ESD myths and why they are not true

Safety (12 items)

- Identify those customer statements that will generate a Safety First issue
- Explain the importance of exercising special care when handling lithium-ion/polymer batteries
- Demonstrate the proper and safe handling of batteries
- Recognize and identify signs and symptoms of damaged batteries
- Respond to events involving embedded batteries

Troubleshooting (8 items)

- Identify the different stages of troubleshooting and service where diagnostic tools are useful
- List the components of clear, concise and complete case notes
- Demonstrate basic troubleshooting and deductive reasoning skills
- Use smart questioning techniques and first-level evaluation and isolation skills to identify issues as being generally hardware based, software based, educational, or environmental in nature

Product Knowledge (15 items)

- List and understand basic iOS controls and navigation
- Identify the components of the default macOS user environment
- List Apple Watch controls and Navigation
- Given a customer scenario, evaluate, isolate, and resolve an Apple ID related issue
- List the steps to configure Continuity services in macOS and in iOS
- Describe how to configure a Bluetooth device in an Apple product
- Identify the methods for backing up and restoring data on an Apple product

Courses in ATLAS

To prepare for the Apple Service Fundamentals Exam, we suggest that you review the courses in the Service Fundamentals subject area in ATLAS. The list of courses in the suggested order can be found in [2019 Service Fundamentals](#).

About the ACiT 2019 iOS Service Certification Exam (iOS-19A)

The ACiT 2019 iOS Service Certification Exam is a computer-based knowledge test that Pearson VUE offers online. This is an open-resource test. We encourage you to use Apple references and courses in ATLAS to answer the questions.

To earn Apple Certified iOS Technician (ACiT) 2019 certification, you need to pass this exam (iOS-19A) and the Apple Service Fundamentals Exam (SVC-19A).

Please note: The Apple Service Fundamentals Exam must be taken before you take the iOS Service Certification Exam.

Exam summary

- Number of sections: 2
- Number of learning objectives: 16
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Sections and topics

Here are the sections and topics covered in ACiT 2019 Exam:

Troubleshooting (41 items)

- Describe the diagnostics used in troubleshooting a given scenario
- Given an isolated issue, categorize the issue as either hardware (including accidental damage), software, environmental, or educational opportunity
- Identify the steps in the iOS setup and activation process
- List common resolutions for battery-related issues
- Identify basic controls for mailbox management
- Describe the built-in apps and features of iOS
- Describe how to personalize and customize iPhone General and Accessibility settings
- Describe the privacy settings that can be put in place for apps

Servicing iPhone (29 items)

- Identify the physical supplies and online resources necessary to ensure proper and safe servicing of an iPhone model
- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of being harmed while servicing iPhone
- Identify the tools that are commonly used to service all iOS models
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 5 and

- SE models
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 6 models
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 7 and iPhone 7 Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 8 and 8 Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone X models

Courses in ATLAS

To prepare for the ACiT 2019 iOS Service Certification Exam (iOS-19A), we suggest that you review the courses in the ACiT subject area in ATLAS. The list of courses in the suggested order can be found in [ACiT 2019 Overview](#).

About the ACMT 2019 Mac Service Certification Exam (MAC-19A)

The ACMT 2019 Mac Service Certification Exam (MAC-19A) is a computer-based knowledge test that Pearson VUE offers online. This is an open-resource test. We encourage you to use Apple references and courses in ATLAS to answer the questions.

To earn Apple Certified Mac Technician (ACMT) 2019 certification, you need to pass this exam (MAC-19A) and the Apple Service Fundamentals Exam (SVC-19A).

Please note: You must complete the Apple Service Fundamentals Exam before you take the Mac Service Certification Exam.

Exam summary

- Number of sections: 2
- Number of learning objectives: 30
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Sections and topics

Here are the sections and topics covered in ACMT 2019 Exam:

Troubleshooting (36 items)

- Evaluate and isolate file system issues with macOS-based systems
- Given a network-related customer issue, accurately evaluate, isolate and resolve the issue
- Correctly identify the diagnostic tool most appropriate to a given troubleshooting scenario
- Describe how to use troubleshooting tools and related procedures
- Identify potential startup issues and associated fixes
- Identify macOS migration tools needed for migration, the types of user data that can be migrated, and the correct methods for migrating user data from both a Mac and PC
- Identify the symptoms that are a result of an SMC that is not functioning correctly
- Explain how to maximize the battery life of an Apple product
- Identify the process to create, configure, manage, and delete user accounts in macOS
- Configure FileVault 2 in macOS to secure the data on a Mac
- Describe the data privacy concerns that are presented when Location Services is enabled in macOS
- Describe the method for resetting a lost Firmware (EFI) password
- Describe how to use Time Machine in macOS to create, restore, and manage a secure data backup

Repairing the Mac Family (34 items)

- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of damaging the customer's Mac while servicing the computer
- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of being harmed while servicing Mac models
- Demonstrate the proper and safe handling of batteries and portable computer case assemblies with built-in battery
- Identify specialized tools, fixtures or procedures required to service iMac

- Identify safety precautions necessary to safely service iMac models
- Identify specialized tools, fixtures or procedures required to service iMac Pro
- Identify safety precautions necessary to safely service iMac Pro models
- Identify specialized tools, fixtures or procedures required to service Mac mini
- Identify specialized tools, fixtures or procedures required to service MacBook Pro 13-inch models
- Identify internal connector types for specific MacBook Pro 13-inch models
- Identify specialized tools, fixtures or procedures required to service MacBook Pro 15-inch models
- Identify internal connector types for specific MacBook Pro 15-inch models
- Identify specialized tools, fixtures or procedures required to service MacBook Air
- Identify specialized tools, fixtures or procedures required to service Mac Pro
- Identify internal connector types for specific Mac Pro models
- Identify safety precautions necessary to safely service Mac Pro models
- Identify specialized tools, fixtures or procedures required to service MacBook

Courses in ATLAS

To prepare for the ACMT 2019 Mac Service Certification Exam (MAC-19A), we suggest that you review the courses in the ACMT subject area in ATLAS. The list of courses in the suggested order can be found in [ACMT 2019 Overview](#).

Frequently Asked Questions

Can anyone take the service certification exams?

Yes. Anyone can take the exams to become an Apple Certified Mac Technician (ACMT) 2019 or Apple Certified iOS Technician (ACiT) 2019.

Successfully completing the exams does not mean that Apple has authorized you to perform repairs or to conduct business directly with Apple or on Apple's behalf. Apple certifies (verifies the skills of) technicians. Apple authorizes (establishes business relationships with) service providers. These two things are not the same.

How do I register for the exams?

Go to <https://certifications.apple.com> to register and create a Tech ID. Then use your [Tech ID](#) to register at an Apple Authorized Training Center or online with Pearson VUE. After you have taken an Apple certification exam, you can track and manage all of your Apple certifications at the certifications website.

Where do I go to take the exams?

You can take the exams online from any internet-connected computer.

How do I prepare for the service certification exams?

Apple provides self-paced training courses in ATLAS. Apple Authorized Service Providers (AASPs) and Self-Servicing Accounts (SSAs) can get the Service Training curriculum online for free.

The Apple Service Fundamentals Exam (SVC-19A) has sections on ESD precautions and technician safety. You must pass these sections in order to pass the exam as a whole.

If I don't pass an exam, how soon can I retake it?

You can retake an exam 24 hours after completing the last attempt.

How do I pay for the exams?

When you register for the certification exams, you can pay with Visa, MasterCard, or American Express.

Where can I verify my exams or certification status?

To verify your exam and certification status, go to <https://certifications.apple.com>. In the "Certification" tab, look for the corresponding Certification Name in "My Certifications" and verify that the status is "Certified". To view exam details, click the relevant Certification Name.

I checked my certification status at certifications.apple.com and it is "In Progress". What does that mean?

If your certifications status is "In Progress", it signifies that not all requirements for the certification were completed. To achieve "Certified" status, some certifications require one or more additional courses or exams to be completed. Click on the Certification Name to review the certification details.

What is the Apple T2 Security Chip course series?

In addition to a valid ACMT certification, completion of Apple T2 Security Chip course series is required prior to servicing Mac computers with the Apple T2 Security Chip. Learners complete the course series by completing the Apple T2 Security Chip Training Assessment ([PQ-061](#)) or the System Configuration for Macs with the Apple T2 Security Chip ([PQ-048](#)).

I have certifications on two different TechIDs. What should I do?

Certifications can be migrated from one TechID to another. Send an email to certifications@apple.com with your exam results and TechID information.

I passed my exam, but when I checked my certification it is not on certifications.apple.com. Why is my certification missing?

Your certifications may take up to 72 hours to appear on certifications.apple.com after you pass the exam. If it has been longer, please send an email to certifications@apple.com.

I have other questions. Where can I get them answered?

You can send your questions to svc.trng@apple.com.

Questions about Apple Certified iOS Technician (ACiT) 2019

What is ACiT 2019?

It's a program to become Apple-certified as an iOS technician.

How is ACiT 2019 different from previous ACiT 2018 certification?

ACiT 2019 qualifies a technician to repair iOS products that were produced before March 15, 2019. This includes:

- iPhone XR
- iPhone XS and iPhone XS Max
- iPad Pro 12.9-inch (3rd generation)
- iPad Pro 11-inch

What exams are required for ACiT 2019?

To get ACiT 2019 certification, you need to pass the Apple Service Fundamentals Exam (SVC-19A) or (SVC-18A) and the ACiT 2019 iOS Service Certification Exam (iOS-19A). These exams are available from Pearson VUE.

Does it matter in what order I take the exams?

Yes. Before you can register for the ACiT 2019 iOS Service Certification Exam (iOS-19A), you must pass the Apple Service Fundamentals Exam 2018 or 2019.

How much does each exam cost?

The cost of the exam is \$20 USD (2,215 yen for Japan). Current pricing is available from Apple Authorized Training Centers or [Pearson VUE](#).

Where do I find the training for these exams?

Training for these exams is available in [ATLAS](#). Access ACiT 2018 courses at Apple-authorized service facilities.

I'm already ACiT 2018 certified. Do I need to take the new ACiT 2019 exams?

No. If you're certified for the iOS products you need to repair, no new exams are required.

Will separate iOS qualification exams be required for new iOS products?

No. Apple will introduce new qualification courses in ATLAS as products are introduced. You have to complete these courses to service these new products. If new products are introduced after you have been certified, you will need to complete the new courses to service those products.

I've completed the SVC-18A exam. How long will the iOS-18A exam be available? Do I need to

take two new exams for ACiT certification?

If you've completed the SVC-18A for ACiT 2018, the ACiT exam will be available until May 14, 2019. Until then, completion of SVC-18A and iOS-18A exams will still grant you ACiT 2018 certification, but it won't cover as many products. To get ACiT 2019 certification, review the updated training materials and successfully complete the iOS-19A exam.

I have completed the Apple Certified Mac Technician (ACMT) 2019 certification. Do I need to take two new exams for ACiT certification?

No. If you are ACMT 2019 certified, you've passed the Apple Service Fundamentals Exam. You only need to pass the ACiT 2019 iOS Service Certification Exam (iOS-19A) to be ACiT 2019 certified.

When I complete the requirements for ACiT 2019, can I request a printed certificate?

Yes. After you pass the required exams, send an email to certifications@apple.com and ask for a certificate. You'll get an email with a link to the request form.

I have other questions. Where can I get them answered?

You can send your questions to svc.trng@apple.com.

Questions about Apple Certified Mac Technician (ACMT) 2019

What is ACMT 2019?

Apple Mac Technician (ACMT) 2019 is a new version of the Apple Certified Mac Technician certification.

How is ACMT 2019 different from previous ACMT certifications?

ACMT 2019 qualifies a technician to repair all the Mac products that were covered by prior ACMT certifications, plus all other Mac products that were produced before March 15, 2019. This includes MacBook and MacBook Pro products that required a separate qualification exam or course in ATLAS:

- MacBook Air (Retina, 13-inch, 2018)
- Mac mini (2018)
- MacBook Pro (15-inch, 2018)
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports)

ACMT 2019 allows a technician who works at an Apple-authorized service facility to service all of these products.

What exams are required for ACMT 2019?

To get ACMT 2019 certification, you need to pass the Apple Service Fundamentals Exam (SVC-19A) or (SVC-18A) and ACMT 2019 Mac Service Certification Exam (MAC-19A). These exams are available from Pearson VUE.

Does it matter in what order I take the exams?

Yes. Before you can register for the ACMT 2019 Mac Service Certification Exam (MAC-19A), you must pass the Apple Service Fundamentals Exam (SVC-19A or SVC-18A)

How much do each of the exams cost?

The cost of the exam is \$20 USD (2,215 yen for Japan). Current pricing is available from Apple Authorized Training Centers or [Pearson VUE](#).

Where do I find the training for these exams?

Training for these exams is available in [ATLAS](#). You can access ACMT 2018 courses at Apple authorized service facilities.

I'm already ACMT 2018 certified. Do I need to take the new ACMT 2019 exams?

No. If you are certified for the Mac products you need to repair, no new exams are required.

I've completed the Apple Certified iOS Technician (ACiT 2018) certification. Do I need to take two new exams for ACMT certification?

No. If you are ACiT 2019 certified, you've already passed the Apple Service Fundamentals Exam. You

only need to take and pass the ACMT 2019 Mac Service Certification Exam (MAC-19A) to be ACMT 2019 certified.

Will separate Mac qualification exams still be available?

Apple will publish new qualification courses in ATLAS for new Apple products as needed. If you're already ACMT certified and want to repair a product with separate qualification requirements, you will be able to complete those specific courses. Credentials will populate GCX and GSX in 48-72 hours.

I've completed one of the previous ACMT 2018 exams. Do I need to take two new exams for ACMT certification?

If you've completed the SVC-18A exam for ACMT, the remaining ACMT exam will be available until May 14, 2019. Until then, completion of SVC-18A and MAC-18A exams will still grant you ACMT 2018 certification, but it won't cover as many products. To get ACMT 2019 certification, review the updated training materials and successfully complete the MAC-19A exam.

What will I have to do to service new Mac products that are introduced after I'm certified?

Apple will introduce new qualification courses in ATLAS as products are introduced. You have to complete these courses to service the new products.

When I complete the requirements for ACMT 2019, can I request a printed certificate?

Yes. After you pass the required exams, send an email to certifications@apple.com and ask for a certificate. You'll get an email with a link to the request form.

I have other questions. Where can I get them answered?

You can send your questions to svc.trng@apple.com.

Take Apart Procedure Notes

Reassembly Steps

When no replacement steps are listed, replace parts in exact reverse order of Removal procedure.

Note About Images in This Guide

In some cases a pre-production model may have been used to document the procedures in this guide. Although there may be small differences in appearance between the image pictured and the computer you are servicing, the procedures are the same unless noted.

Screw Sizes

All screw sizes shown are approximate and represent the total length of the screw.



iMac (Retina 5K, 27-inch, 2019) Repair Videos List

In these videos, learn how to properly replace internal components in the course of a repair.

- [Display Panel Removal and Replacement Video](#)
- [Flash Storage Replacement Video](#)
- [Hard Drive Data and Power Cable Replacement Video](#)
- [Hard Drive Replacement Video](#)
- [Logic Board Replacement Video](#)
- [Power Supply Replacement Video](#)

For issues with video content or playback, email the **AppleCare Media Production** team at **servicevideos@group.apple.com**.

Note: You may not receive a response, but all comments will be reviewed and investigated as needed.

iMac (Late 2012–2019) and iMac Pro (2017) Required Tools

Required Tools for iMac (Late 2012 – 2019) and iMac Pro (2017) Models

The following tools are required to service these models:

- iMac Pro (2017)
- iMac (Retina 5K, 27-inch, Late 2014, Mid 2015, Late 2015, 2017, and 2019)
- iMac (27-inch, Late 2012 and Late 2013)
- iMac (Retina 4K, 21.5-inch, Late 2015, 2017, and 2019)
- iMac (21.5-inch, Late 2012, Early 2013, Late 2013, Mid 2014, Late 2015, 2017)

For more information about tools, refer to [OP101: Apple notebooks and desktops: Hand Tools for Repairs](#).

General Tools

- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags, to store ESD-sensitive parts while removed from the computer
- ESD-safe tweezers.
- Black stick or other nonconductive nylon or plastic flat-bladed tool
 - Black stick, pack of 4 (922-5065)
 - Black stick, pack of 24 (922-9004)
 - Black stick, pack of 96 (922-9005)
- Digital volt meter, for troubleshooting
- Earphones, for audio cable reassembly
- Kapton tape
- Magnifying glass, for reading the serial number
- Pentalobe driver (923-0367), for VESA mount
- Phillips #00 screwdriver
- Sticky notes
- Thunderbolt and USB cables, for logic board replacement
- Torx T4 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Torx T6 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Torx T10 screwdriver (magnetized)
- Torx T25 screwdriver (magnetized), for 27-inch models
- Adjustable torque driver 0.3–1.2 Nm (923-0735)
- T8 security bit (923-0734)
- Logic Board Service Tray (076-00376)
- Phillips PH2 bit
- Access Card for iMac Pro (923-02298)

Display Tools

The display is secured to the rear enclosure using adhesive strips. When a repair requires the removal of the display panel, the very high bond (VHB) adhesive strips must be cut and replaced.

Display starter kit and refill kits

Model	Starter kit	Refill kit
iMac (21.5-inch, Late 2012)	076-1444	076-1437
iMac (21.5-inch, Early 2013)	076-1444	076-1437
iMac (21.5-inch, Late 2013)	076-1444	076-1437
iMac (21.5-inch, Mid 2014)	076-1444	076-1437
iMac (21.5-inch, Late 2015)	076-1444	076-1437
iMac (21.5-inch, 2017)	076-00330	076-00331
iMac (Retina 4K, 21.5-inch, Late 2015)	076-1444	076-1437
iMac (Retina 4K, 21.5-inch, 2017)	076-00330	076-00331
iMac (Retina 4K, 21.5-inch, 2019)	076-00330	076-00331
iMac (27-inch, Late 2012)	076-1444	076-1419
iMac (27-inch, Late 2013)	076-1444	076-1419
iMac (Retina 5K, 27-inch, Late 2014)	076-1444	076-00009
iMac (Retina 5K, 27-inch, Mid 2015)	076-1444	076-00009
iMac (Retina 5K, 27-inch, Late 2015)	076-1444	076-00009
iMac (Retina 5K, 27-inch, 2017)	076-00330	076-00332
iMac (Retina 5K, 27-inch, 2019)	076-00330	076-00332
iMac Pro (2017)	076-00374	076-00375

Display starter kit contains:

- Display removal tool (1) (the white handle shown here), also available separately as 076-00108
- Display removal wheels (8) (the black circle on the left side of tool shown here)

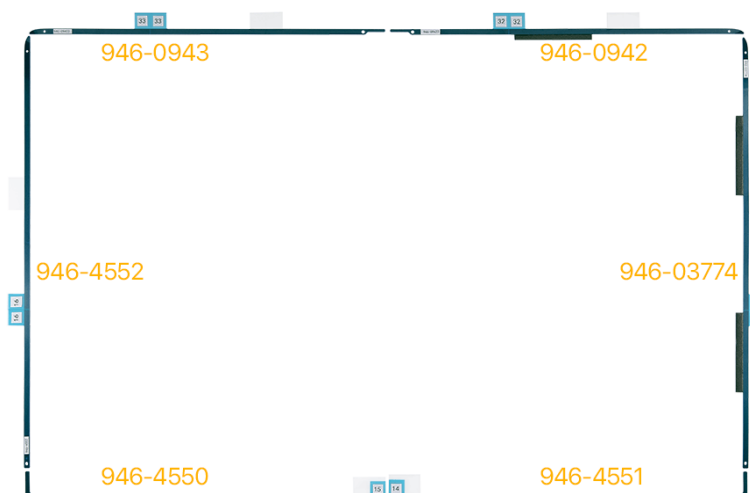


- iMac service wedge (not available separately)

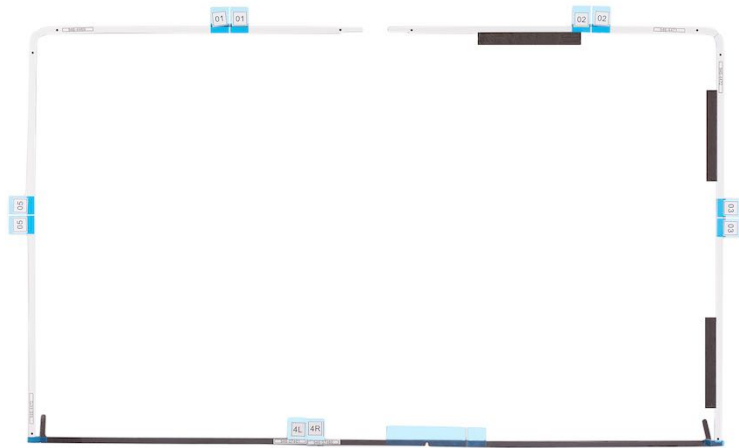
Note: The number on the side of the service wedge (944-4365) is an Apple internal part number used for identification. It is not an orderable service part.



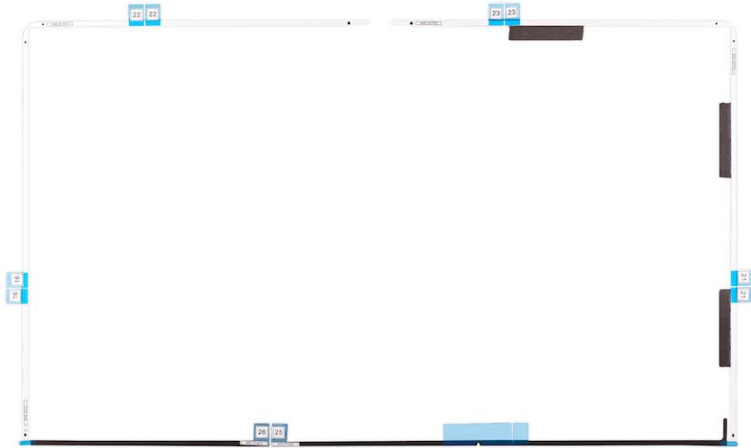
- VHB adhesive strip 6-piece set for iMac Pro (2017)



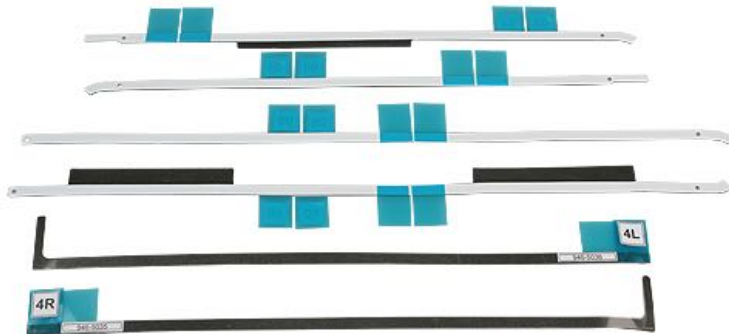
- VHB adhesive strip 6-piece set for iMac (Retina 4K, 21.5-inch, 2017 and 2019)



- VHB adhesive strip 6-piece set for iMac (Retina 5K, 27-inch, 2017 and 2019)



- VHB adhesive strip 6-piece set for iMac (21.5-inch, Late 2012–Mid 2015 models)



Display refill kits contain:

- Display removal tool (1), also available separately as 076-00108
- Display removal wheels (20), also available separately as 076-1417
- VHB adhesive strip 6-piece set (20 sets)

Other display tools:

- Display cable extension kit, to test the display panel and cables with the display panel removed

Model	Extension Kit
iMac (21.5-inch, Late 2012)	076-1428
iMac (21.5-inch, Early 2013)	076-1428
iMac (21.5-inch, Late 2013)	076-1428
iMac (21.5-inch, Mid 2014)	076-1428
iMac (21.5-inch, Late 2015)	076-1428
iMac (21.5-inch, 2017)	076-1428
iMac (Retina 4K, 21.5-inch, Late 2015)	076-00200
iMac (Retina 4K, 21.5-inch, 2017)	076-00373
iMac (Retina 4K, 21.5-inch, 2019)	076-00373
iMac (27-inch, Late 2012)	076-1431
iMac (27-inch, Late 2013)	076-1431
iMac (Retina 5K, 27-inch, Late 2014)	076-00010
iMac (Retina 5K, 27-inch, Mid 2015)	076-00010
iMac (Retina 5K, 27-inch, Late 2015)	076-00010
iMac (Retina 5K, 27-inch, 2017)	076-00010
iMac (Retina 5K, 27-inch, 2019)	076-00010
iMac Pro (2017)	076-00377

- Display removal tool (076-00108)
- Display removal wheels, pack of 20 (076-1417)
- ESD bags, 27x18-inch, pack of 5 (923-01193), for a 27-inch display
- ESD bags, 21x16-inch, pack of 5 (923-01194), for a 21.5-inch display
- Isopropyl alcohol (IPA) wipes, 95% or higher isopropyl
- LCD service support stand (923-0416), to support the LCD panel or when working on a VESA rear housing.



- Painter's tape (tape that does not leave a residue, 1 to 2 inches wide, but preferably 2-inch, if available)
- Polishing cloths, anti-static, optical-grade microterry, pack of 5 (922-8263)
- Power supply protective covers (923-0189), to use when performing live adjustments with the display panel removed
- Sticky silicone roller (6-inch) (922-8261), to adhere VHB strips to the display panel
- Sticky sheet pads (922-8262), to clean silicone roller or pick up shards of broken glass

Wireless Card Tools

- Thermal pad kit (076-1445)
 - Note:** Whenever removing or replacing the wireless card, check for any original thermal material. If it is present, then remove the original thermal material, clean the area with an IPA wipe, and install one thermal pad to the wireless card.
- Antenna tool (optional)
 - 923-01322



- Wireless card support tools
 - 923-03086 for iMac (Retina 4K, 21.5-inch, 2019)



- 923-03085 for iMac (Retina 5K, 27-inch, 2019)



- 923-02218 for iMac Pro (2017)



- 923-01806 for iMac (21.5-inch, 2017) and iMac (Retina 4K, 21.5-inch, 2017)



- 923-01807 for iMac (Retina 5K, 27-inch, 2017)



- 923-00774 for iMac (21.5-inch, Late 2015) and iMac (Retina 4K, 21.5-inch, Late 2015)



- 923-00775 for iMac (Retina 5K, 27-inch, Late 2015)



iMac (27-inch, Late 2012 – 2019) Safety

Safety for iMac (27-inch, Late 2012 – 2019)



Warning: HIGH VOLTAGE. Use extreme caution when troubleshooting with the display panel removed. Avoid touching the logic board or power supply while the computer is plugged in, the power supply retains a charge whether or not the computer is on.

After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.

- Never remove or install any physical components while the computer is plugged in to an electrical outlet.
- When plugged in, the power supply and logic board are energized, even when the computer is turned off.
- Unplug the computer and allow sufficient time for the power supply and logic board to self-discharge before removing the display panel.
- Do NOT touch the logic board or power supply while the computer is plugged in, or before sufficient time has passed to discharge stored voltage to a safe level after being unplugged.

Refer to article [TP833: iMac and Displays: Power Supply Cover Instructions](#) for additional information on installing the protective covers. The power supply cover provides protection against unintended contact with the energized power supply, which may result in injury from electric shock. ALWAYS use the protective power supply cover during service when the glass panel and LCD have been removed from the iMac, LED Cinema Display, and Thunderbolt Display.

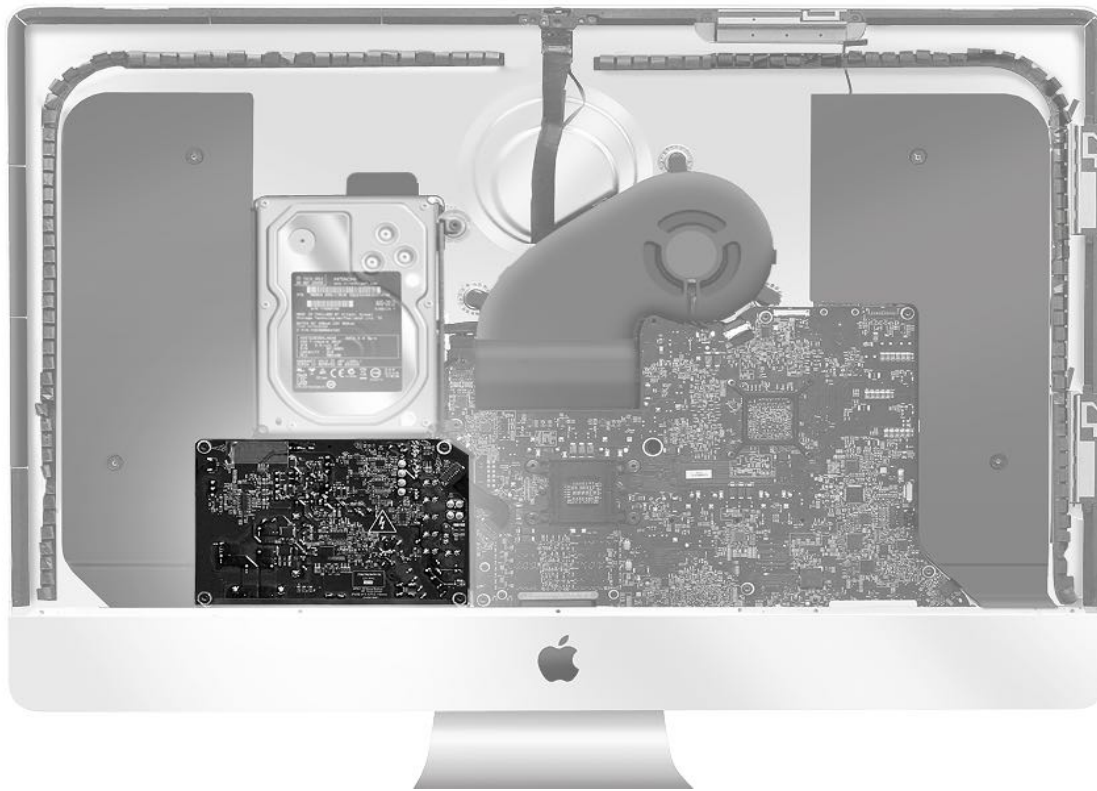
Warning: iMac (Late 2012 – 2019) models require two protective covers (923-0189) when performing live adjustments; one for the power supply and one for the backlight control circuitry on the logic board. Secure the covers to the rear housing with tape, as shown in the last image below.

Electrical Safety Precautions

Before working on a computer with exposed, potentially energized parts:

- Remove rings, watches, necklaces, metal-rimmed eyewear, and other metallic articles which increase your risk of electric shock.
- Do not wear a cell phone or other signaling device, as these may cause a dangerous startle reflex during energized work.
- **If the iMac needs to be plugged in for LED checks or similar troubleshooting, do NOT wear an ESD wrist strap.** Wearing an ESD grounding system increases your risk of electric shock in this situation.
- Remain alert, focused on the work being performed, and aware of the proximity of grounded objects to your body.
- Use a black stick or other non-metal extension tool as needed to connect or disconnect cables, to keep fingers away from potentially energized parts.

iMac (27-inch, Late 2012 – 2019): Power supply location



iMac (27-inch, Late 2012 – 2019): Logic board location



iMac (27-inch, Late 2012 – 2019): Protective power supply cover placement

Warning: Use the protective power supply covers when the computer is plugged in or when performing live adjustments. On these models, place a cover over both the power supply and the logic board when doing live adjustments. Secure the covers to the rear housing with tape, as shown below. Avoid touching the logic board or power supply while the computer is plugged

in and the display panel is removed.

Refer to articles:

- [TP833: Power Supply Cover Instructions](#)
- [TP981: Testing the Panel Using the Display Extension Cable Kit](#)



Power Supply Cover Instructions



WARNING: HIGH VOLTAGE: The power supply remains powered up whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed. Avoid touching the logic board or power supply while the computer is plugged in.

- Never remove or install any physical components while the computer is plugged in to an electrical outlet.
- When plugged in, the power supply and logic board are energized, even when the computer is powered off.
- Unplug computer and allow sufficient time for the power supply and logic board to self-discharge before removing display panel.
- Do NOT touch the logic board or power supply while the computer is plugged in, or before sufficient time has passed to discharge stored voltage to a safe level after being unplugged.

Discharge wait time:

iMac models Late 2011 and earlier, LED Cinema Display, and Thunderbolt Display:

- Wait one hour after unplugging the computer from the electrical outlet before removing the power supply or working near the power supply leads.

iMac models Late 2012 and later:

- Wait two minutes after unplugging the computer from the electrical outlet before removing display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.

Electrical Safety Precautions:

Before working on a computer with exposed, potentially energized parts:

- Remove rings, watches, necklaces, metal-rimmed eyewear, and other metallic articles which increase your risk of electric shock.
- Do not wear a cell phone or other signaling device, as these may cause a dangerous startle reflex during energized work.
- **If the iMac needs to be plugged in for LED checks or similar troubleshooting, do NOT wear an ESD wrist strap.** Wearing ESD grounding systems increases your risk of electric shock.
- Remain alert, focused on the work being performed, and aware of the proximity of grounded objects to your body.
- Use the plastic black stick or other non-metal extension tool as needed to connect or disconnect cables, to keep fingers away from potentially energized parts.

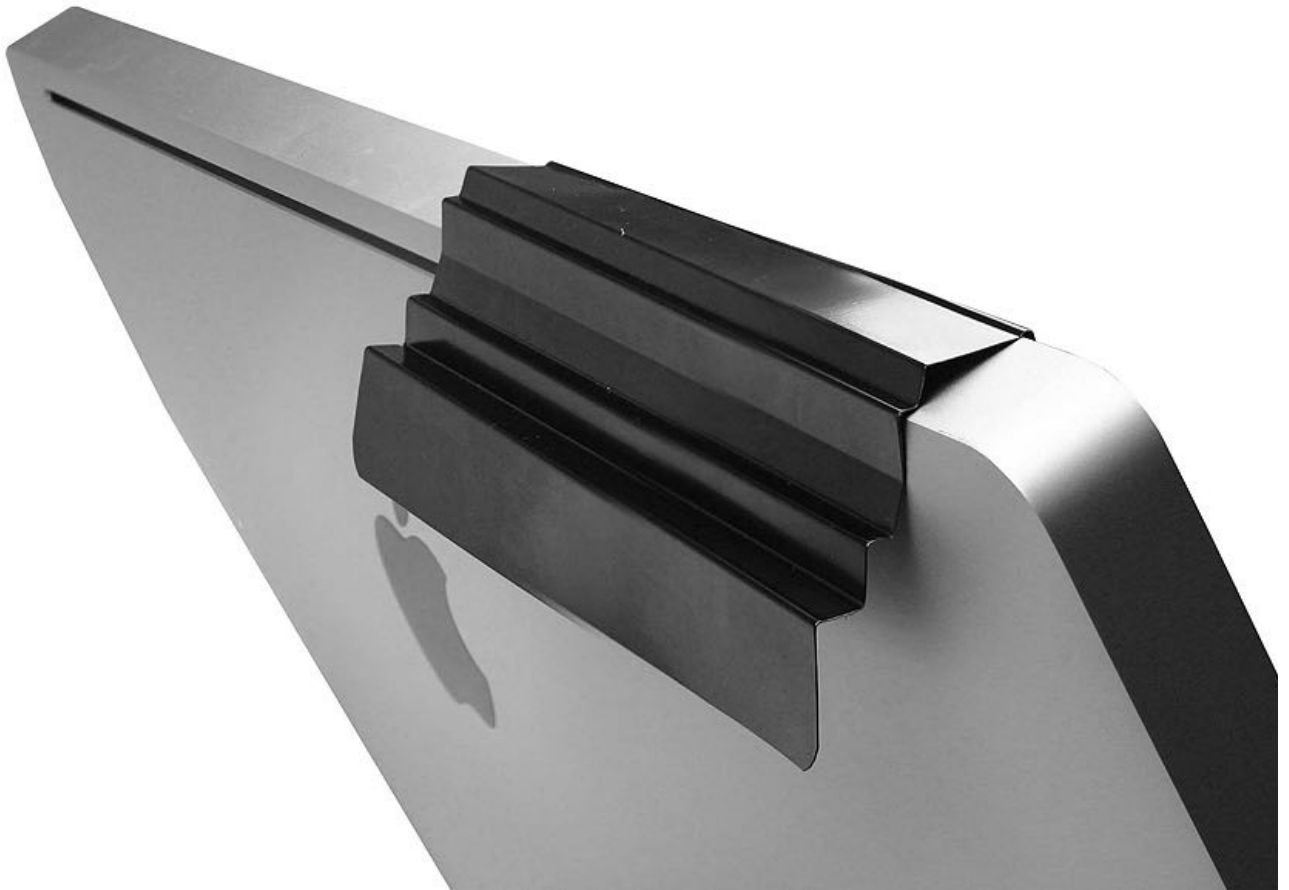
Tools Required

- A ruler
 - Kapton tape or painter's tape
 - Power supply protective cover, 923-0189, pkg. of 2
1. Before using the power supply cover for the first time, position the cover with the part number face-down, then fold the cover once to create a 90-degree bend. The fold location is marked by a linear indentation (see dotted line in image) in the cover. Use a ruler as a guide to make the fold.

Note: The iMac (Late 2012 and later) models require two protective covers when performing live adjustments; one for the power supply and one for the backlight control circuitry on the logic board. Secure the covers to the rear housing with tape, as shown in step 5.

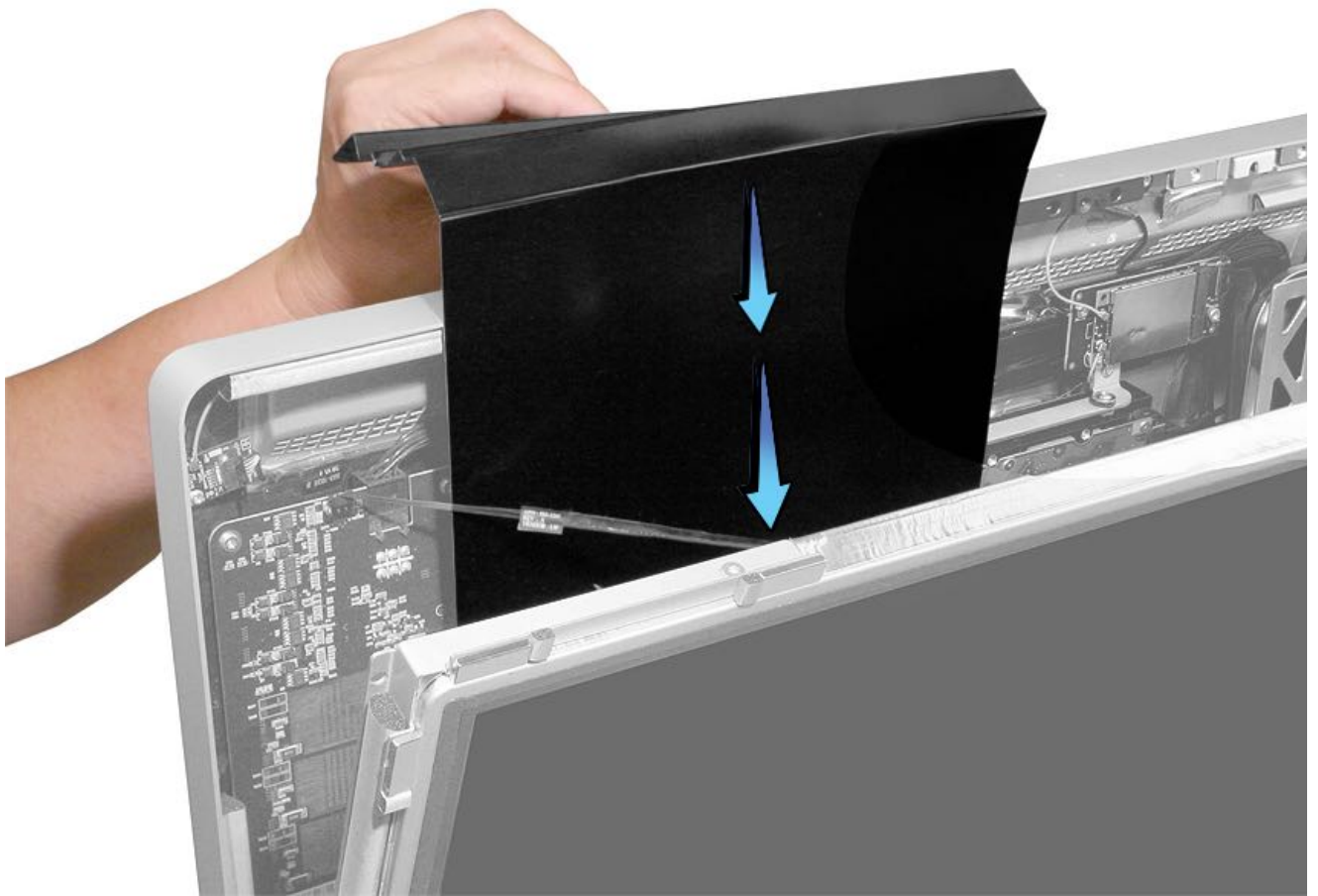


2. The pre-formed bends allow the cover to fit the rear housing on a variety of iMacs and displays (as shown).

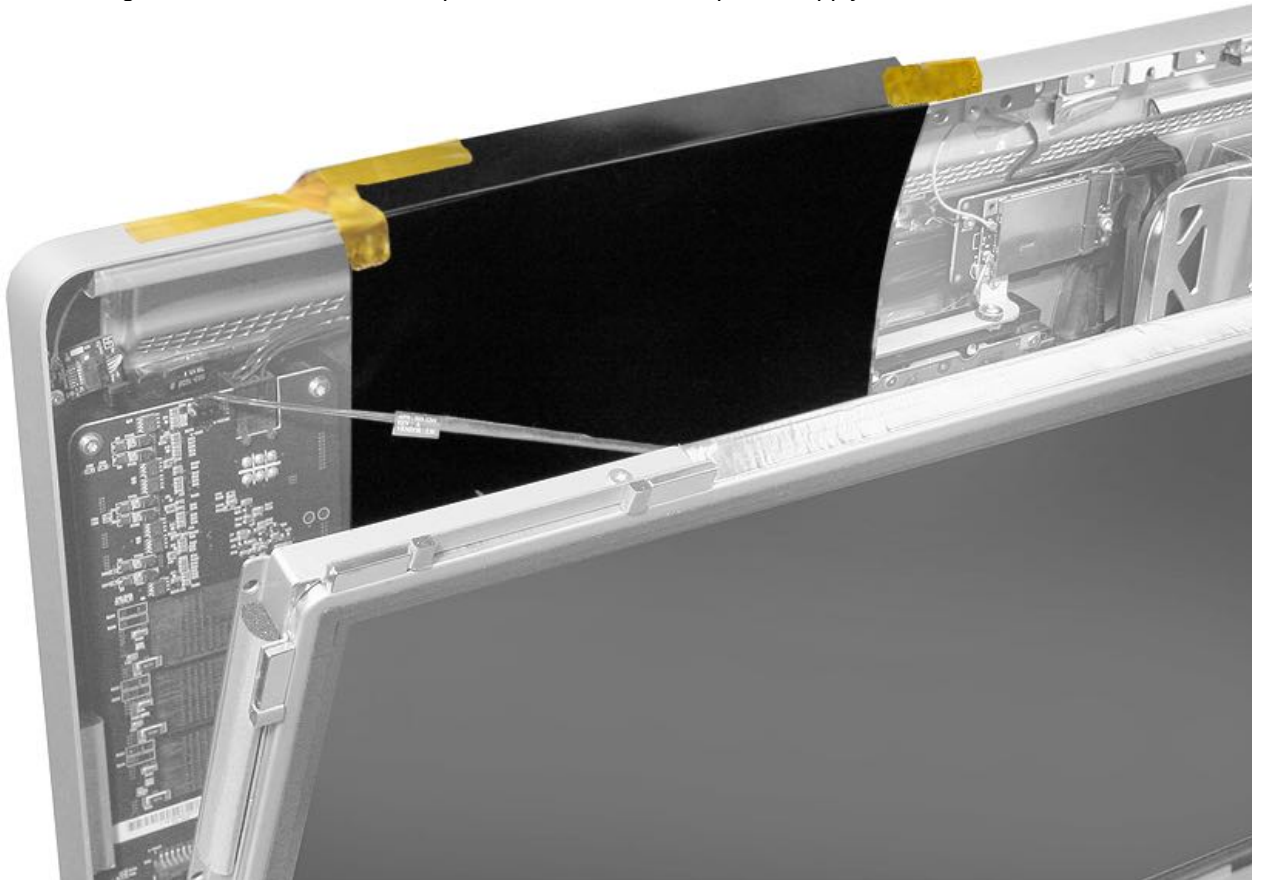


3. On older iMac models, before removing the LCD, tilt the panel open three inches and carefully slide the power supply cover into place. Hang the cover over the rear housing, covering the power supply.

Note: The iMac (Late 2012 and later) models require two protective covers when performing live adjustments; one for the power supply and one for the backlight control circuitry on the logic board. Secure the covers to the rear housing with tape, as shown in step 5.



4. Secure the power supply cover with Kapton or painter's tape along the top edge of the rear housing to prevent the shield from sliding. **Note:** Refer to the model-specific Service Guide for power supply cover instructions.



WARNING: Due to the immediate proximity of the power supply in some iMac models, do not use fingertips to

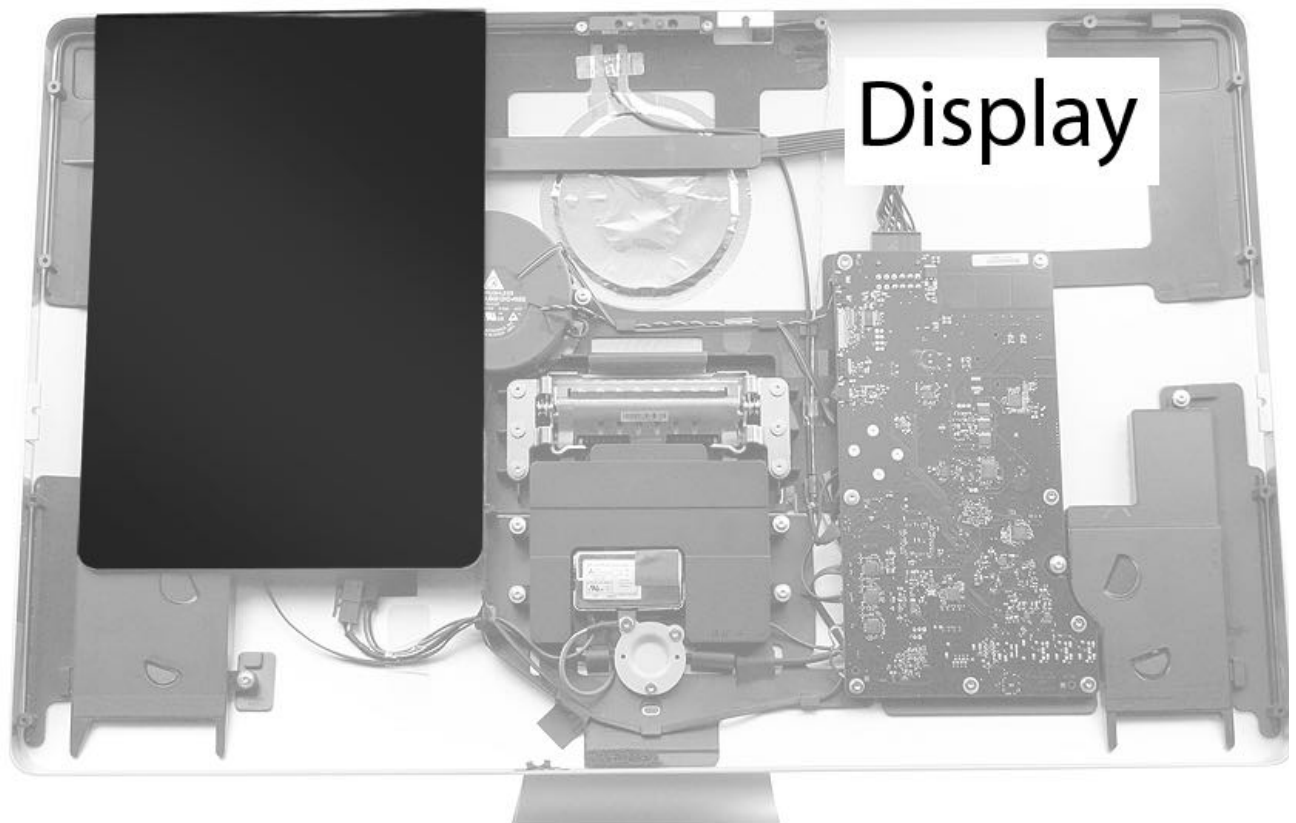
disconnect the LCD backlight controller cable. Use a black stick as directed in model-specific Apple Service Guide instructions to keep your fingertips away from the electrical hazard.

5. Make sure the energized modules are completely covered. On older models, the power supply should be covered as completely as possible before reaching into the system to disconnect display cables, remove modules, or perform live testing. On iMac models (Late 2012 and later), cover both the power supply and logic board. Refer to the last two images in this step for their cover placement.

iMac models (Late 2011 and earlier) protective power supply cover placement

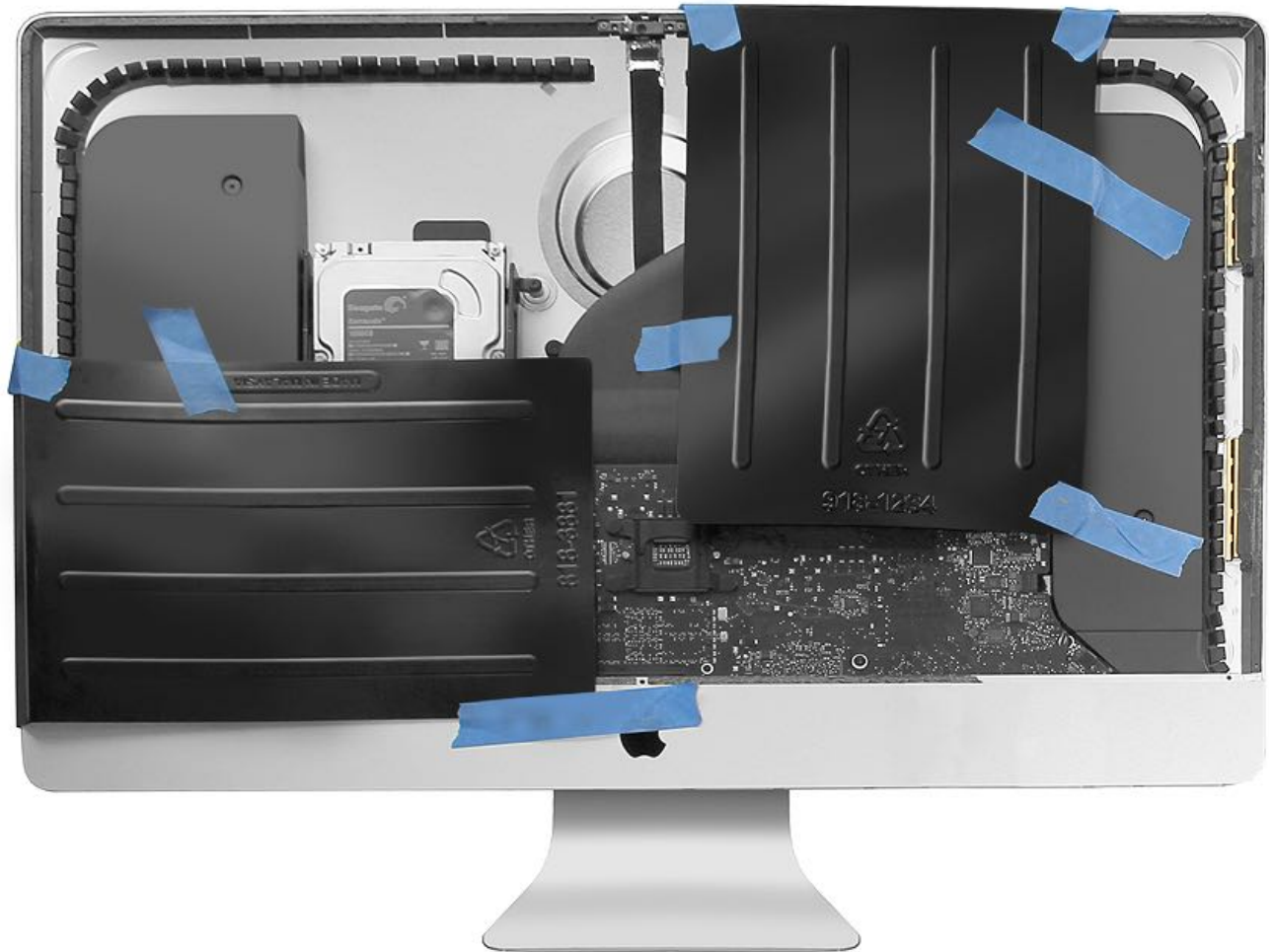


LED Cinema Display and Thunderbolt Display protective power supply cover placement



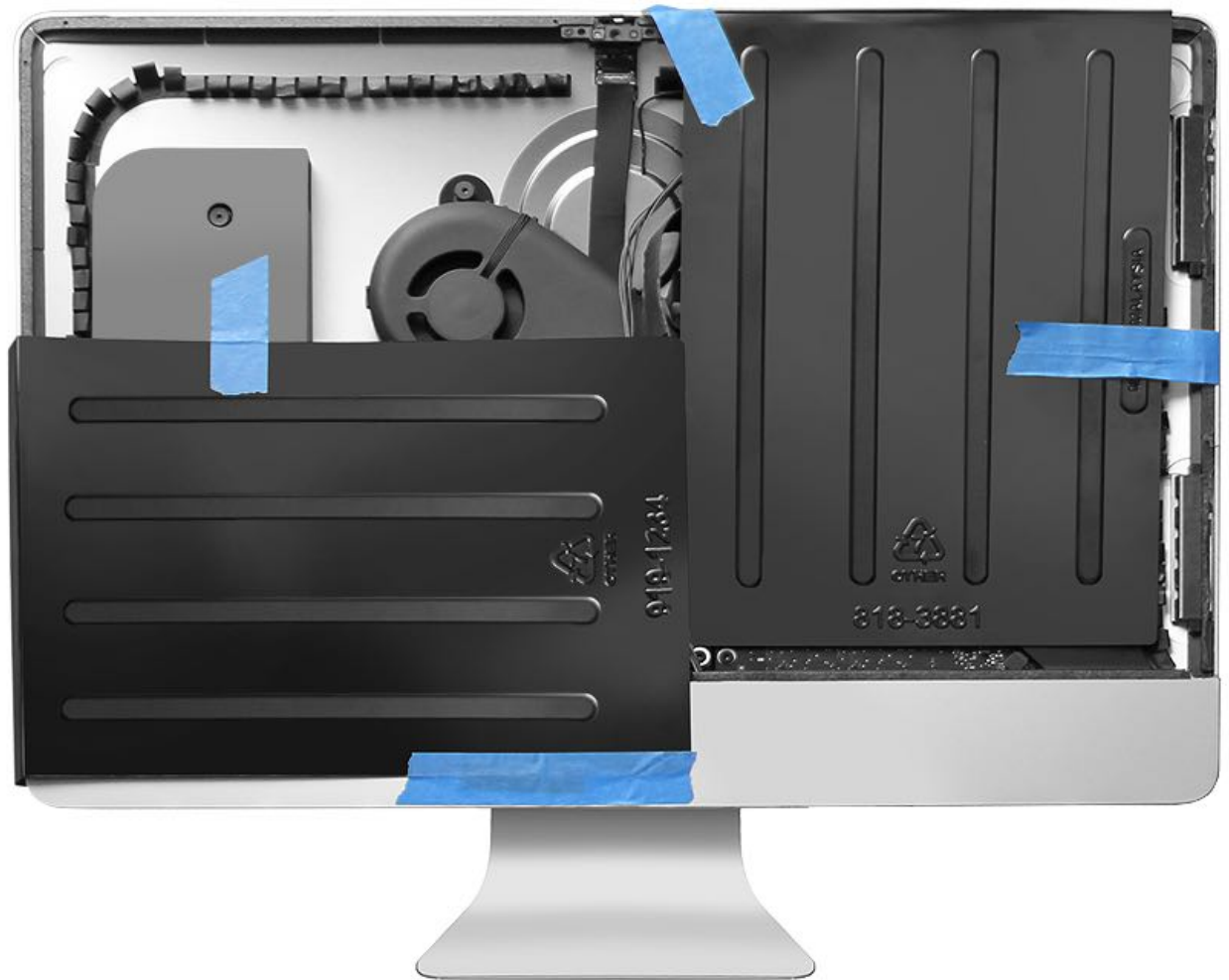
iMac (27-inch, Late 2012 and later) protective power supply cover placement

Warning: On these models, place a cover over both the power supply and logic board when doing live adjustments. Avoid touching the logic board or power supply while the computer is plugged in.



iMac (21.5-inch, Late 2012 and later) protective power supply cover placement

Warning: On these models, place a cover over both the power supply and logic board when doing live adjustments. Avoid touching the logic board or power supply while the computer is plugged in.



6. The power supply protective cover may be reused. However, before reusing, visually inspect shield for:
 - Holes, tears, punctures, or cuts.
 - Textural defects such as swelling, softening, hardening, or stickiness.
 - Other defects that degrade insulating quality.
7. If any wear or other defects are found, discard the shield, and use a new cover (part number 923-0189).

Cleaning and Handling a Broken Display Panel

Cleaning and Handling a Broken Display Panel for iMac (Late 2012–2019) and iMac Pro (2017)

Tools for Cleaning the Display Panel

- Safety glasses
- iMac service wedge (included with the display panel starter kit, 076-1444)
- Clean, damp cloth (to clean display panel glass)
- Isopropyl alcohol (IPA) wipes (to remove residual VHB adhesive)

Cleaning the Display Panel

1. Clean the front of the display with a clean, damp, lint-free cloth.
Note: Do not use IPA wipes to clean the display. IPA wipes should only be used to remove residual VHB adhesive.
2. Polish the display panel with an antistatic, microfiber, optical-grade polishing cloth (922-8263, package of five).



Glass Safety Precautions

All models have a glass display panel that attaches to the front of the computer, which must be removed to access internal components.

Handling a Broken Display Panel

- The display panel glass is not tempered and will break into sharp pieces if mishandled. Removing the display panel requires special tools.
- Safety glasses are recommended when removing the display panel.



Tools

- Display panel starter kit (Refer to [TP818: Required Tools](#) for part numbers.)
- Material handling gloves (such as leather or cut-resistant gloves)
- Packing tape or equivalent
- Safety glasses
- Large ESD bags (922-8258) – 24x20-inch bags that accommodate a 21.5-inch display, package of five
- Large ESD bags (922-9468) – 24x30-inch bags that accommodate a 27-inch display, package of five
- Large box

Safety Information



If the display panel breaks and a glass shard enters the eye:

- Seek medical attention immediately!
- Do not rub your eye if you feel you have something in your eye.
- Do not use an eye wash. An eye wash can push or move the shard of glass and cause more damage.
- Keep the eye closed or loosely patch the eye to keep the eye from moving.

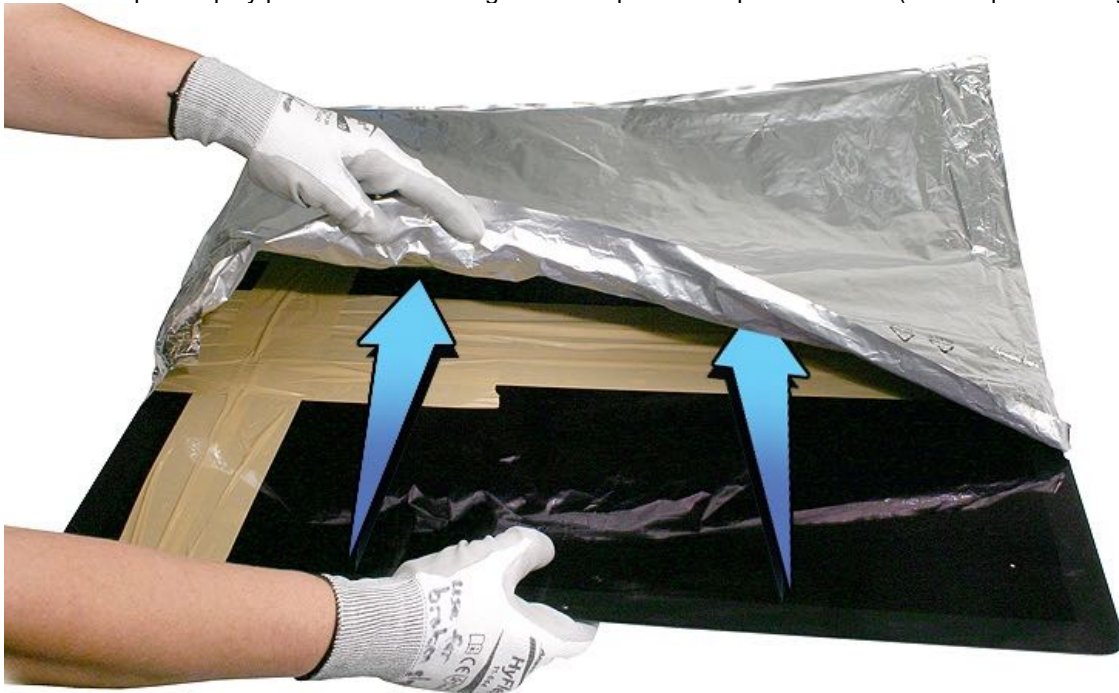
Handling a Broken Display Panel

1. Put on safety glasses and material handling gloves.
2. If the display panel is broken and is still attached to the rear housing, then secure the broken glass with packing tape and carefully follow the Display Panel Removal procedure.
 - [RP1021: iMac \(21.5-inch, Late 2012, Early 2013, Late 2013, Mid 2014\): Display Panel Removal](#)
 - [RP1230: iMac \(21.5-inch, Late 2015 and 2017\) and iMac \(Retina 4K, 21.5-inch, Late 2015 and 2017\): Display Panel Removal](#)
 - [RP950: iMac \(27-inch\) Display Panel Removal](#)
 - [RP1403: iMac Pro \(2017\) Display Panel Removal](#)
 - [RP1482: iMac \(2019\) Display Removal](#)
3. Lay the display panel on a smooth, clean work surface.

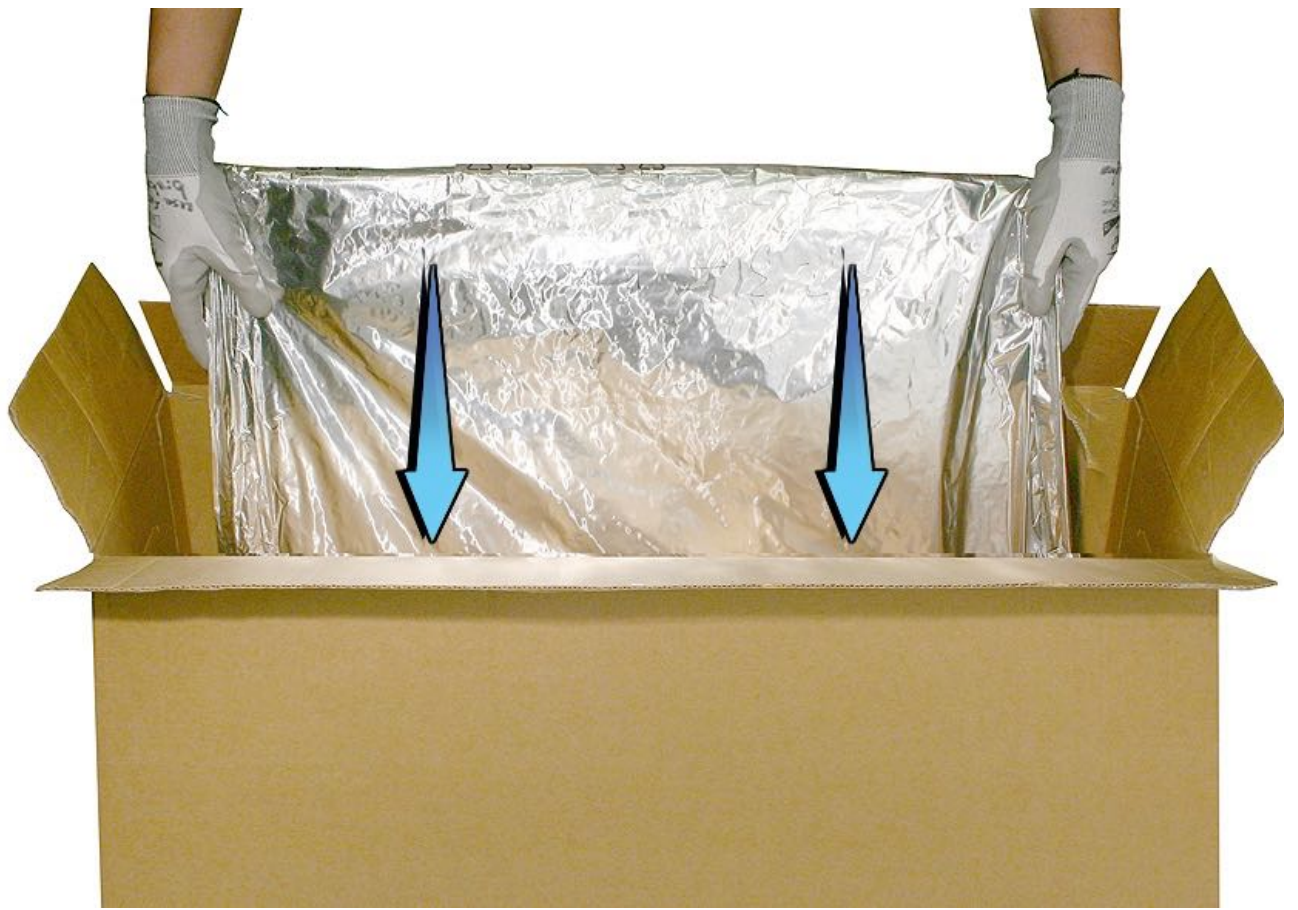
4. Apply tape, thoroughly covering the broken display panel.



5. Place the taped display panel in the ESD bag that the replacement panel came in (or an equivalent large bag).



6. Place the display panel inside a large box, label the box "Broken Glass," and return the display back to Apple using the normal return process.



iMac (Retina 5K, 27-inch, 2019) Memory

First Steps

Before you Begin:

- Shut down the computer. Unplug power and disconnect peripherals.
- Lay the computer face down on a soft, clean towel or cloth to prevent scratching the display.
- Put on an ESD wrist strap.



Tools

No tools are required for this procedure.

Steps For Removal

1. Open the memory compartment door by pressing the small grey button located just above the AC power port.



2. The memory compartment door will open as the button is pushed in. Remove the compartment door and set it aside.
Note: A diagram on the underside of the memory cover shows the memory cage levers and the orientation of the DIMM.



3. Locate the two levers on the right and left sides of the memory cage. Push the two levers outward to release the memory cage:



4. After the memory cage is released, pull the memory cage levers toward you, allowing access to each DIMM slot.



5. Remove a DIMM by pulling the module straight up and out. Note the location of the notch on the bottom of the DIMM. When reinstalling DIMMs, the notch must be oriented correctly or the DIMM won't fully insert.



Steps For Reassembly

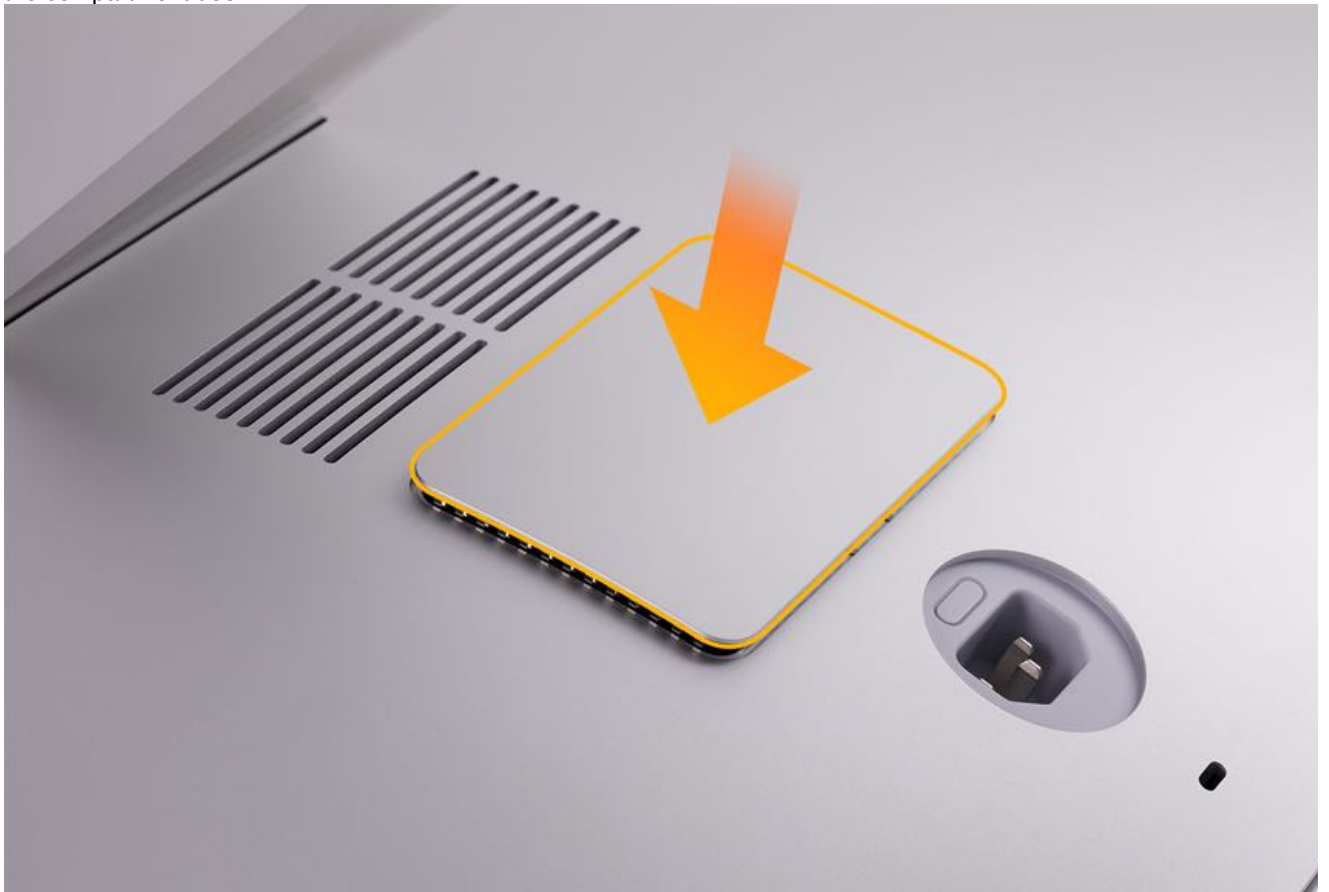
1. Replace or install a DIMM by setting it down into the slot and pressing firmly until you feel the DIMM click into the slot. **Important:** Ensure the DIMM is fully seated and has clicked into place. If the DIMM is not fully seated, the computer may not recognize the DIMM and may not turn on.



2. After you install all of your DIMMs, push the memory cage levers back into the housing until they click back into place.



3. Replace the memory compartment door. You don't need to press the compartment door release button when replacing the compartment door.



4. Place the computer in its upright position. Reconnect the power cord and all other cables to the computer, then start up the computer.

iMac (2019) Display Removal

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).



This procedure is shared between iMac (Retina 4K, 21.5-inch, 2019) and iMac (Retina 5K, 27-inch, 2019). Images in this shared procedure may show one model, but the steps to perform the repair are the same for both.

For video instruction, refer to [SV116: Display Panel Removal and Replacement Video](#).

Always perform the following steps before starting a repair:

- Turn off the computer.
- Unplug the power cord from the electrical outlet.
- Disconnect all cables.
- Put on an ESD wrist strap.



Tools

1. iMac service wedge
2. Black stick
3. Display removal tool and replacement wheels
4. Safety glasses
5. Isopropyl alcohol (IPA) wipes
6. iMac LCD service support stand (923-0416)



The display panel is attached to the rear housing with very high bond (VHB) adhesive strips. Each VHB strip has one foam layer surrounded by two adhesive layers. To remove the display panel, you must use the display removal tool to cut the VHB strips. When you cut the VHB strips, you are cutting mostly through the foam layer. The display removal tool has replaceable wheels that you can use five to ten times. If a wheel is nicked, you must replace it.



Steps For Removal



Warning: In the unlikely event that the display glass cracks or breaks, refer to [TP819: Cleaning and Handling a Broken Display Panel](#).

1. Place the service wedge on the stand with the stand hole covered. Rotate the computer so the display panel is facing you.



2. Insert the display removal tool at a 90 degree angle in the top left corner between the display panel and rear housing. Roll the tool across the top of the computer, avoiding the 3-inch area surrounding the camera.



Caution: Failure to lift the tool out of the computer to avoid the camera could damage the display and the camera.



3. Continue to roll the tool around the top right corner and down along the right side of the computer.



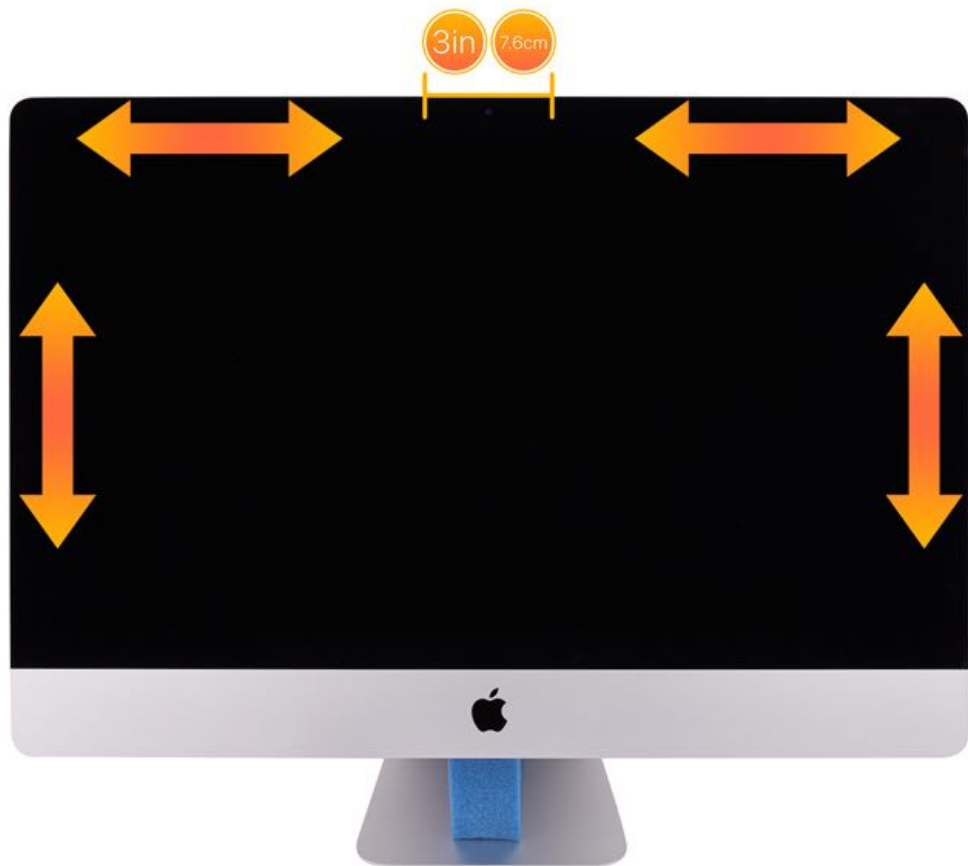
Note: Ensure that the tool makes steady contact with the display panel and rear housing at the top corners.



4. Roll the tool around the top left corner and down along the left side of the computer.



5. Roll the tool back and forth along the top and sides of the computer until the wheel moves with minimal resistance.
Note: Use the display removal tool only along the top and sides of the computer.



6. Insert the flat end of a black stick up to the notch between the display panel and rear housing. Slide the black stick along the edge to cut any remaining adhesive.



Caution: Do not twist, pry, or insert the black stick past its notch especially along the antenna sections. Forcing the black stick between the display panel and the rear housing may fracture the display panel.





7. Separate the display panel from the top of the rear housing. If there is resistance, repeat steps 2 through 6.



8. Tilt the display open just enough for your hand to reach the cables connecting the display panel to the logic board.



Caution: Do not attempt to remove the display panel. The bottom edge is still attached with display adhesive. Do not stress the display cables and connectors on the logic board when tilting the display open. If the connectors on the logic board are damaged, you will need to replace the logic board.



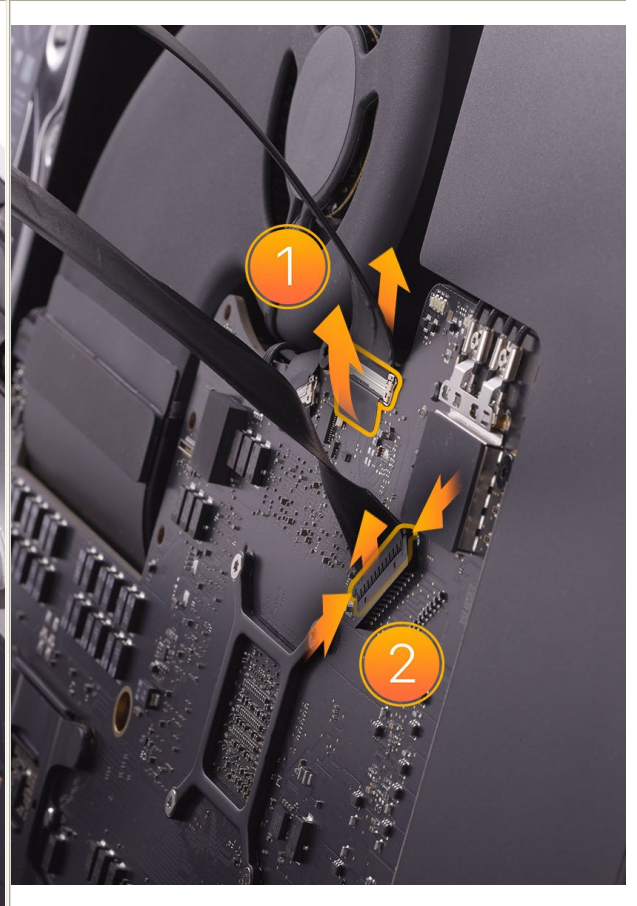
9. Disconnect the Embedded DisplayPort (eDP) cable (1) and the display backlight power cable (2).

Note: The display backlight power cable is part of the display panel and is not available as a separate part.

iMac (Retina 4K, 21.5-inch, 2019)



iMac (Retina 5K, 27-inch, 2019)



10. Use your hand to support the display panel as you further tilt it toward you.



11. Locate the display adhesive tabs at the bottom corners of the display panel and pull each toward the center to release the display panel from the rear housing.



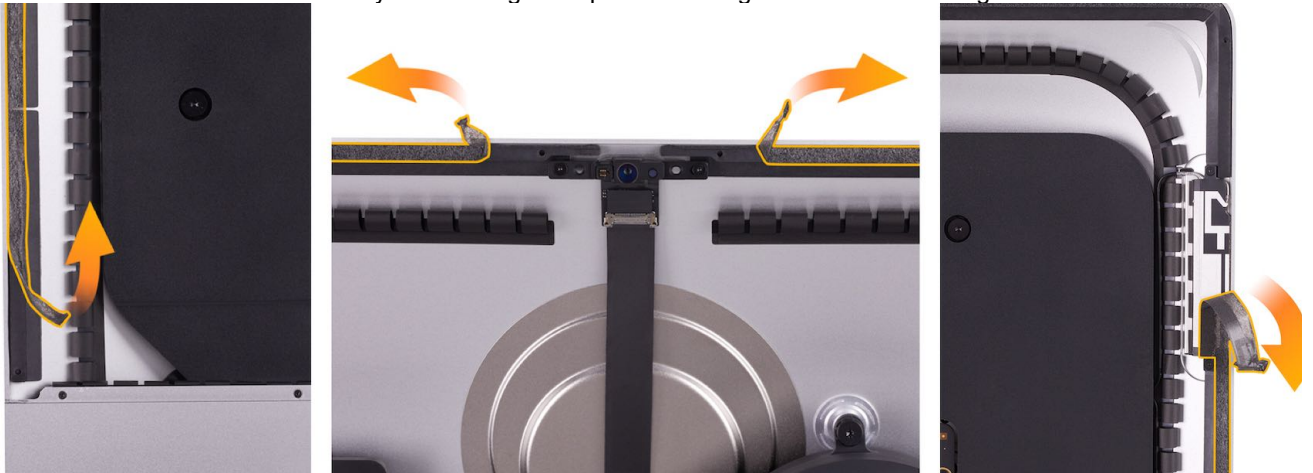
Caution: If the display panel is sticking to the rear housing, use a black stick to break the display adhesive bond.



12. Pull the display panel from the rear housing and set it on the display support stand.



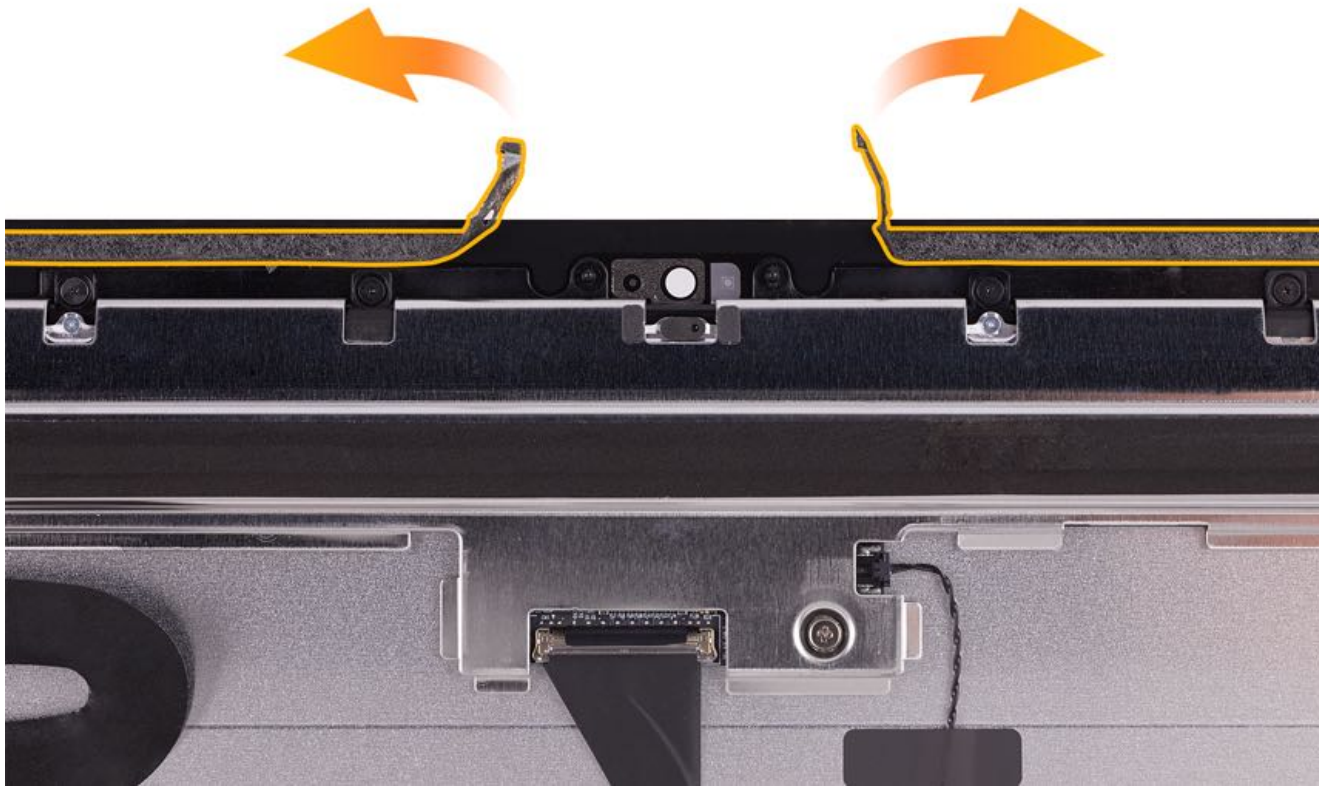
13. Use your fingers and the flat end of a black stick to remove any residual adhesive from the rear housing.
Note: Residual adhesive can be anywhere along the top and side edges of the rear housing.



14. Use your fingers and the flat end of a black stick to remove any residual adhesive from the display panel. Residual adhesive can be anywhere along the top and side edges of the display panel.

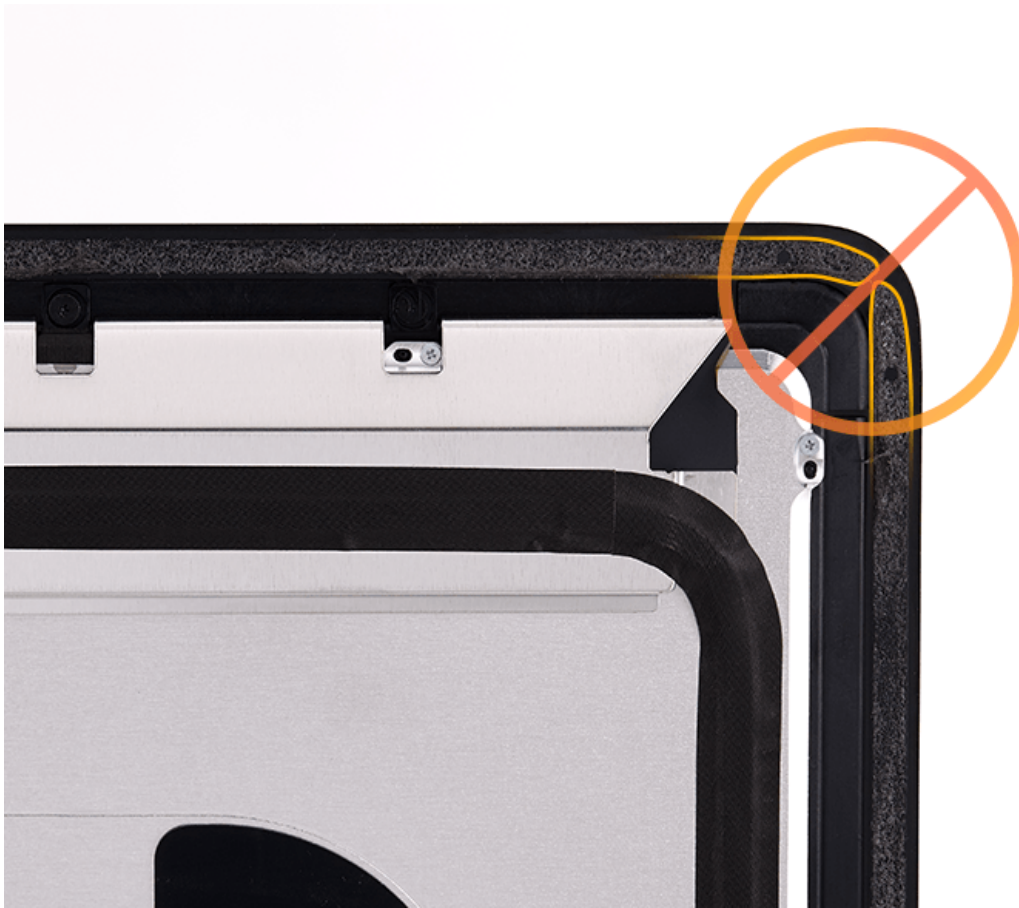


Caution: To prevent damaging or accidentally removing the Mylar protective film on the display panel glass, do not peel the residual adhesive from the top corners. Always peel the top residual adhesive outward from the center. Always peel the side residual adhesive upward from the bottom.





Caution: Do not peel residual adhesive inward or downward from the top corners.

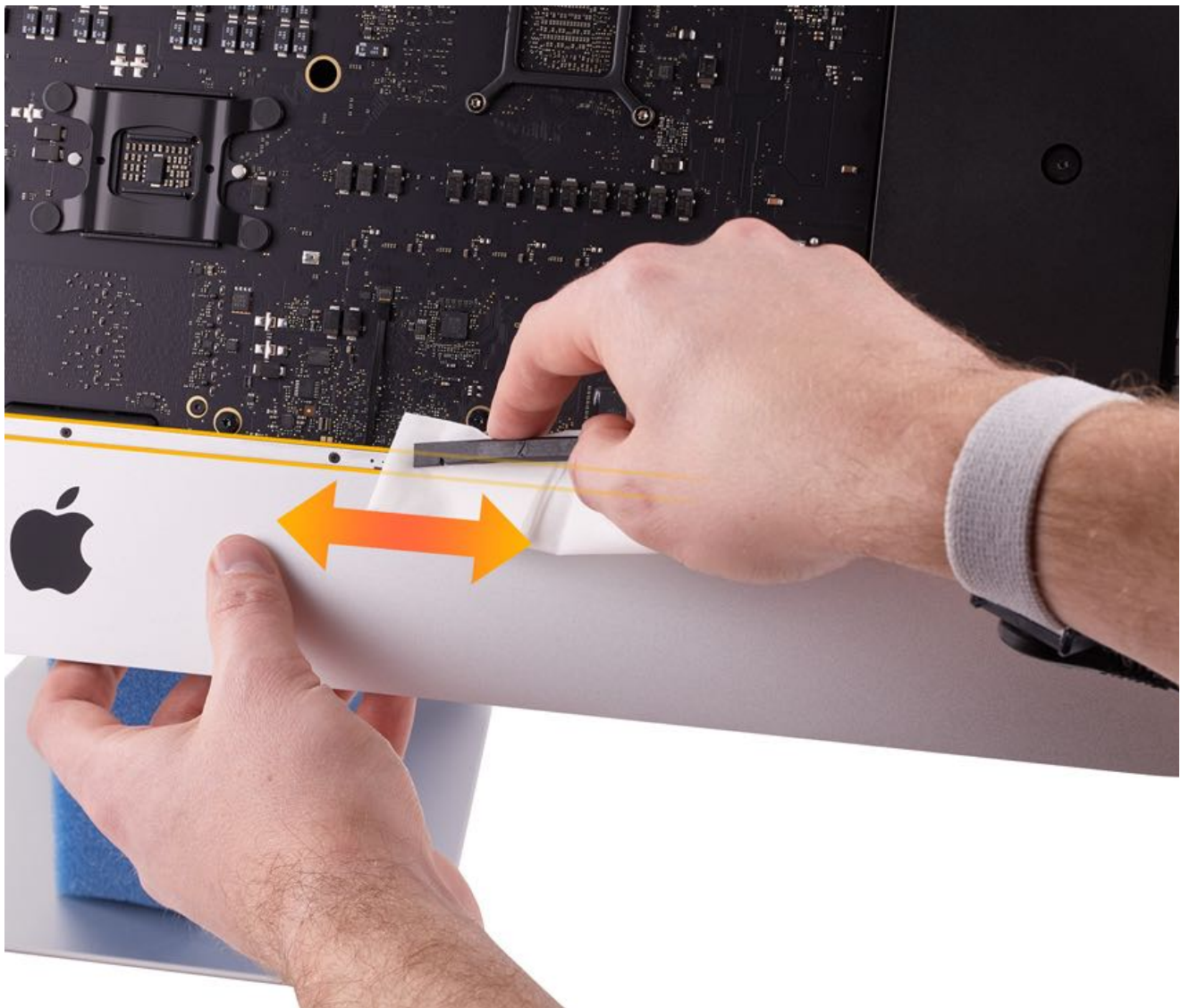


Note: If the black protective Mylar film is peeled or wrinkled on the display, then press the film back onto the panel with your finger. The Mylar should be smooth and undamaged. Use care when working around the Mylar film. If the Mylar is pulled from the display, then you may need to replace the display.

15. Use an IPA wipe to remove any remaining adhesive from the rear housing and display panel edges. Allow the surfaces to dry for one minute.



Caution: Do not use IPA wipes on the front of the display or to remove anything other than residual adhesive.



16. Recheck the display panel and rear housing for any remaining residual adhesive.

Steps For Reassembly

Reinstall the [display](#) to complete reassembly.

iMac (2019) Display Reassembly

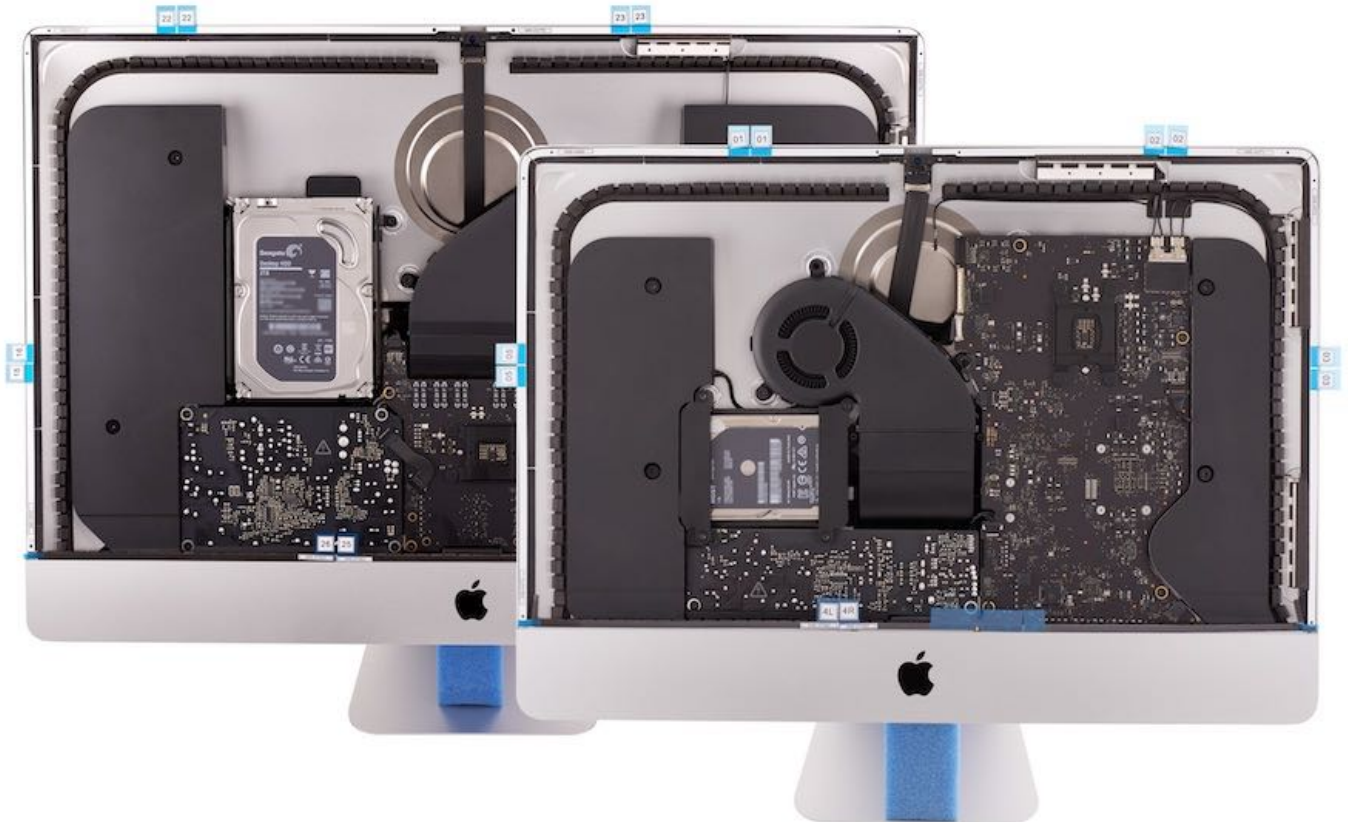
First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).



This procedure is shared between iMac (Retina 4K, 21.5-inch, 2019) and iMac (Retina 5K, 27-inch, 2019). Images in this shared procedure may show one model, but the steps to perform the repair are the same for both.

For video instruction, refer to [SV116: Display Panel Removal and Replacement Video](#).



Tools

1. Black stick
2. Silicone display roller
3. iMac service wedge
4. Isopropyl alcohol (IPA) wipes
5. Safety glasses
6. Clean, damp, lint-free cloth
7. Painters tape (1 to 2 inches wide)



Steps For Removal

Before proceeding with the display reassembly:

- Use Isopropyl alcohol (IPA) wipes to ensure that any residual display adhesive is removed from the display panel and rear housing.
- Verify that all cables are connected and all screws are installed.
- Confirm that there is no debris in the computer.

For additional information on removing residual display adhesive, refer to [RP1482: Display Removal](#).

Steps For Reassembly

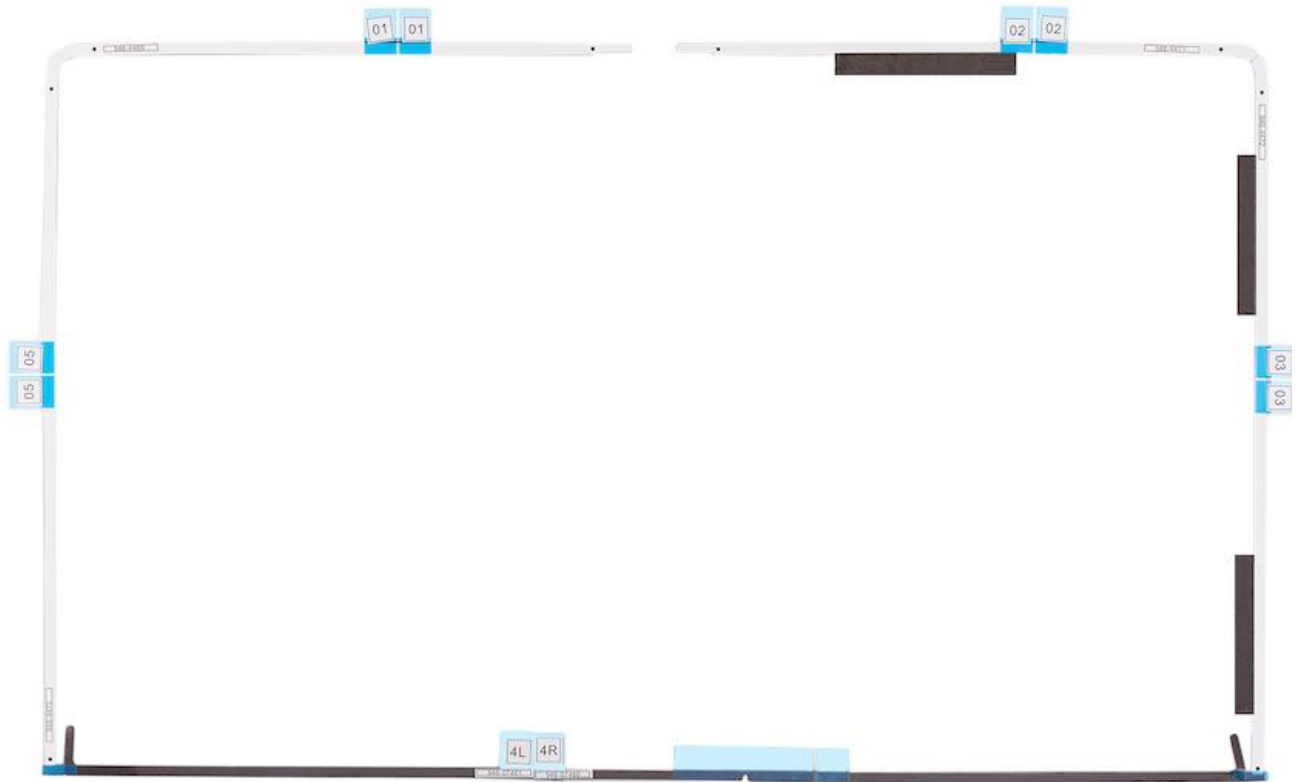
Before you begin:

Each display adhesive strip has an ID number on the pull tab and a part number on the strip. Use the table and images below to verify that you have the required display adhesive strips. Lay out the display adhesive strips and check them for wrinkles and exposed sections. Damaged strips can cause cosmetic gap issues, weaken the display bond, or create light leakage.

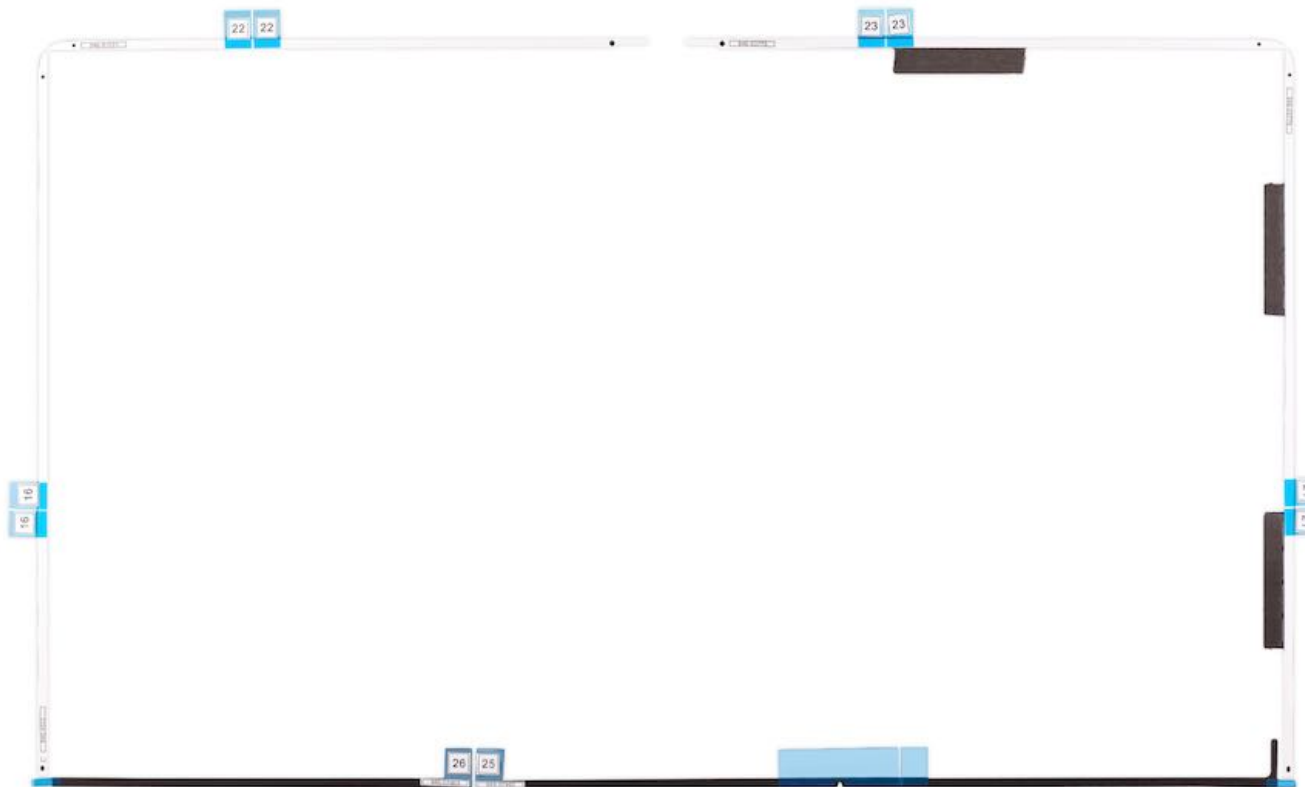
- iMac (Retina 4K, 21.5-inch, 2019) Refill Kit: 076-00331
- iMac (Retina 5K, 27-inch, 2019) Refill Kit: 076-00332

21.5" Display Adhesive Strip Location	ID Number	Part Number
Top Left	1	946-4469
Top Right	2	946-4471
Left Side	5	946-4470
Right Side	3	946-4472
Bottom Left	4L	946-07461
Bottom Right	4R	946-07460
27" Adhesive Strip Location	ID Number	Part Number
Top Left	22	946-01031
Top Right	23	946-03775
Left Side	16	946-4552
Right Side	21	946-03774
Bottom Left	26	946-07463
Bottom Right	25	946-07462

- Display adhesive strips layout for iMac (Retina 4K, 21.5-inch, 2019):



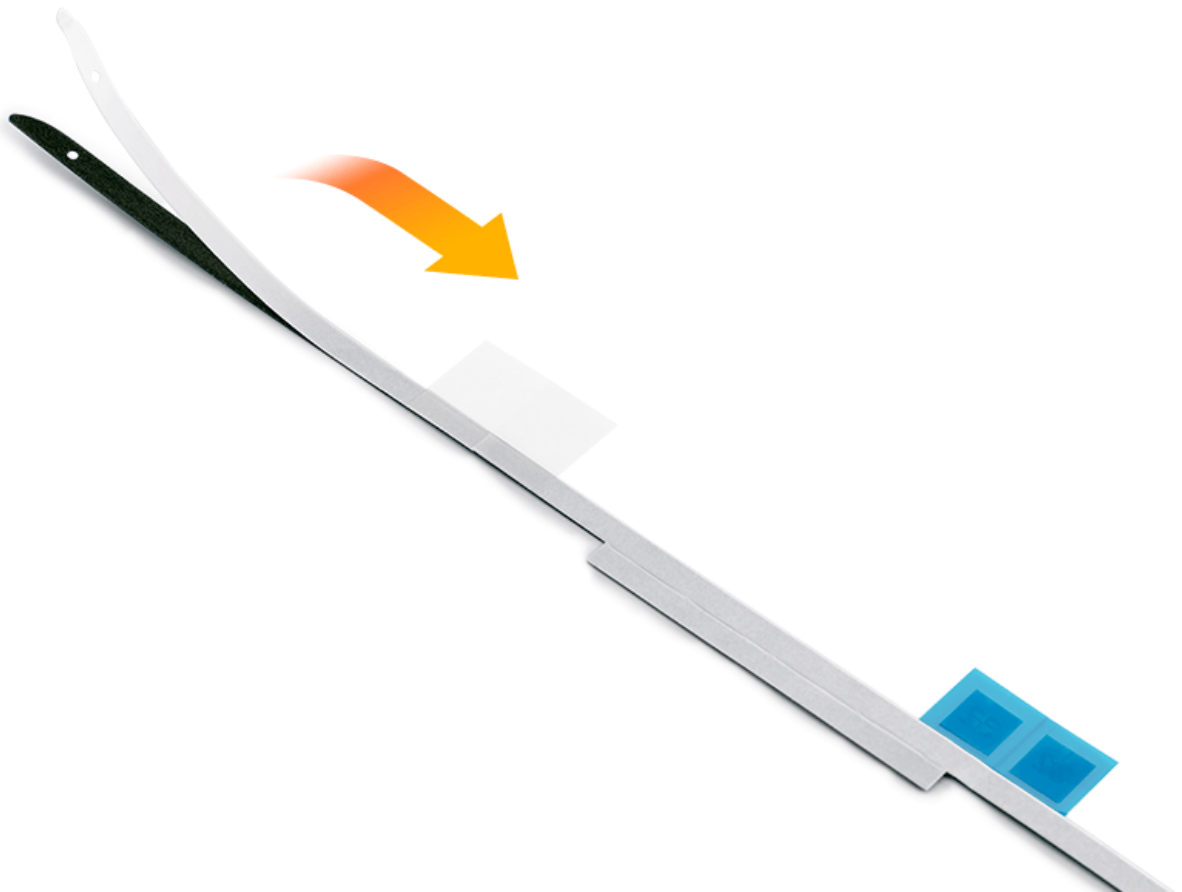
- Display adhesive strips layout for iMac (Retina 5K, 27-inch, 2019):



- **Display Adhesive Strips:**

The display adhesive strips consist of two layers of very high bond (VHB) adhesive with a foam layer in the middle. There is a removable paper liner on the underside and a plastic liner on the top side. Use the pull tabs to peel the paper liners from the display adhesive strips.

Note: The color of the removable liner may vary.



- **Alignment Holes:**

Use the eight alignment holes on the top and sides of the rear housing to align the new display adhesive strips.



Apply Display Adhesive Strips:

1. Use the pull tab on the back of the display adhesive strip to remove the top portion of the paper liner (1). Leave the remaining paper liner (2) on the lower half of the strip.
2. Use the pointed end of a black stick to align the display adhesive strip on one side of the rear housing.



3. As you position the top portion of the display adhesive, use the pull tab to peel the remaining paper liner from the underside of the display adhesive strip.



4. Use your finger to press the display adhesive strip into place on the rear housing. If a display adhesive strip does not line up correctly, remove it and start again.

Important: Do not remove the clear plastic liners from the top layer of the strip at this time.

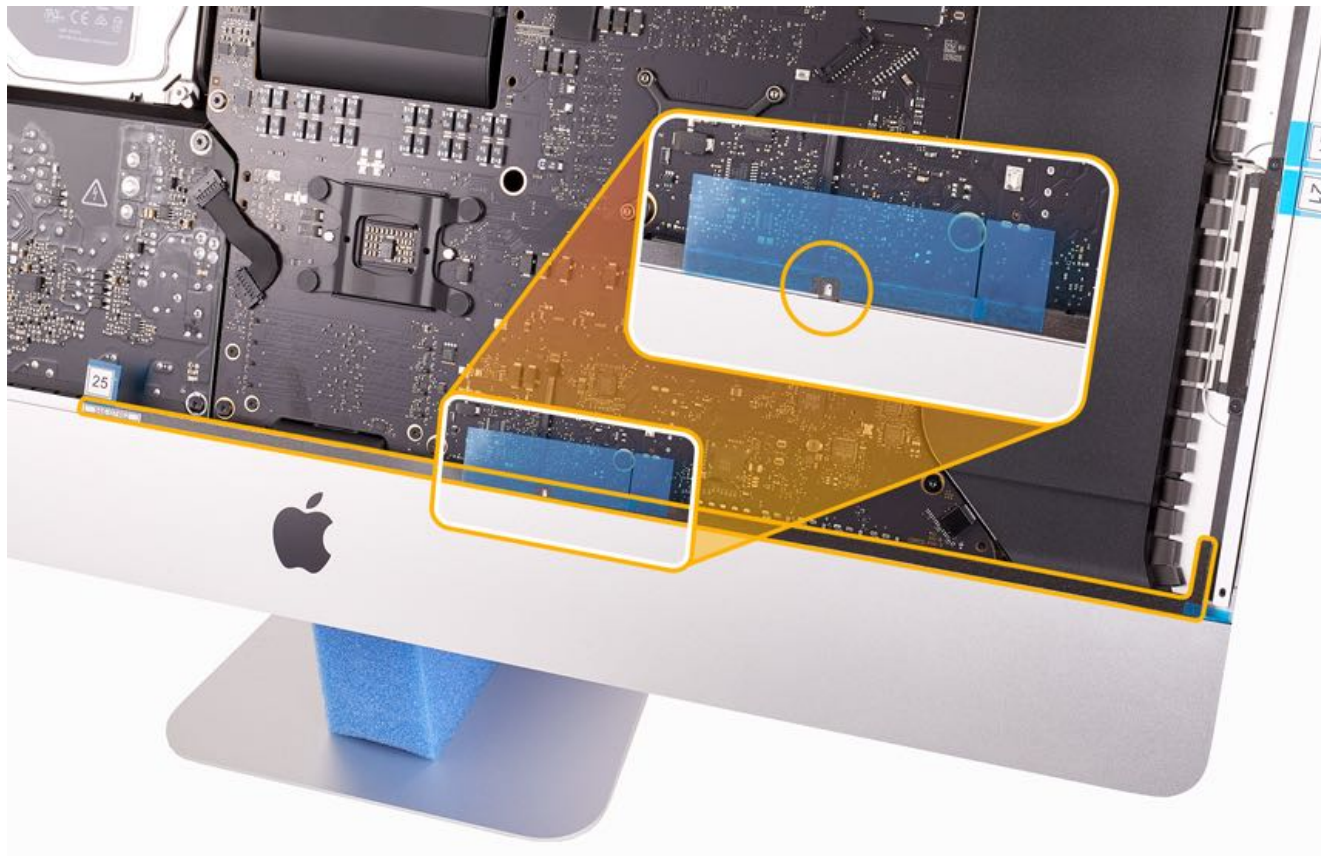


5. Repeat steps 1 through 4 along the top inside edge and other side of the rear housing.



6. Adhere the two strips of display adhesive along the bottom edge of the rear housing. There are no guide holes on the display adhesive strips or along the bottom of the rear housing, so align the strips by hand.

Important: The bottom right adhesive strip has a notch for the microphone opening.



Important: If a display adhesive strip does not line up correctly, remove it, clean the rear housing, and start again. Check that there are no wrinkles or exposed sections on the strip.

Install the Display Panel:

7. Place the display panel on the chin of the rear housing. Align the panel and check that it is centered and seated.



8. Hold the display removal tool against the sides of the display to check the alignment. Adjust if necessary.

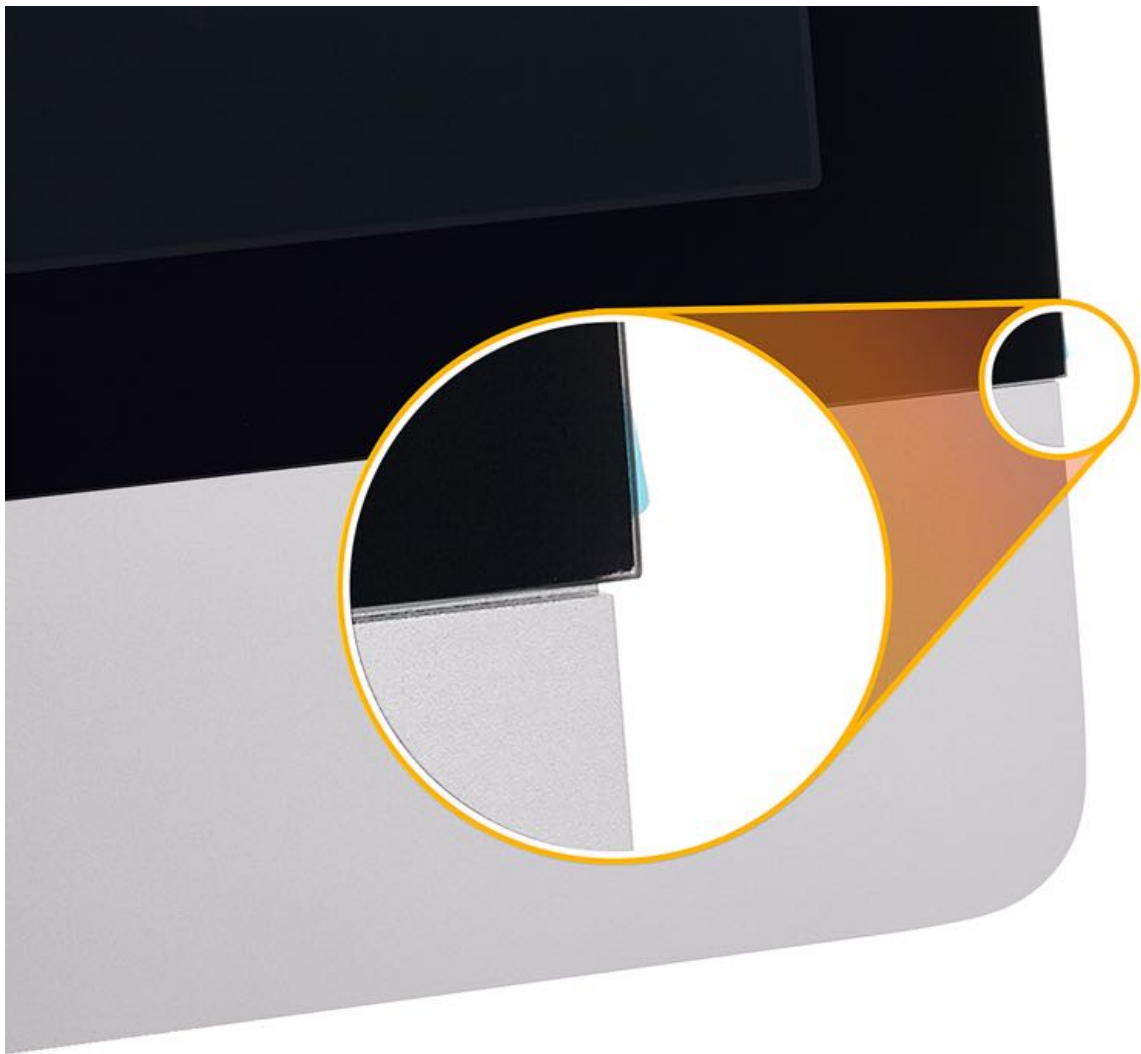


9. Anchor the display panel to the chin with a horizontal strip of painters tape. Place the tape along the chin, where the bottom of the display meets the rear housing.



10. Stand back to check the alignment of the display panel. If you can see the rear housing, adjust the panel and check again.

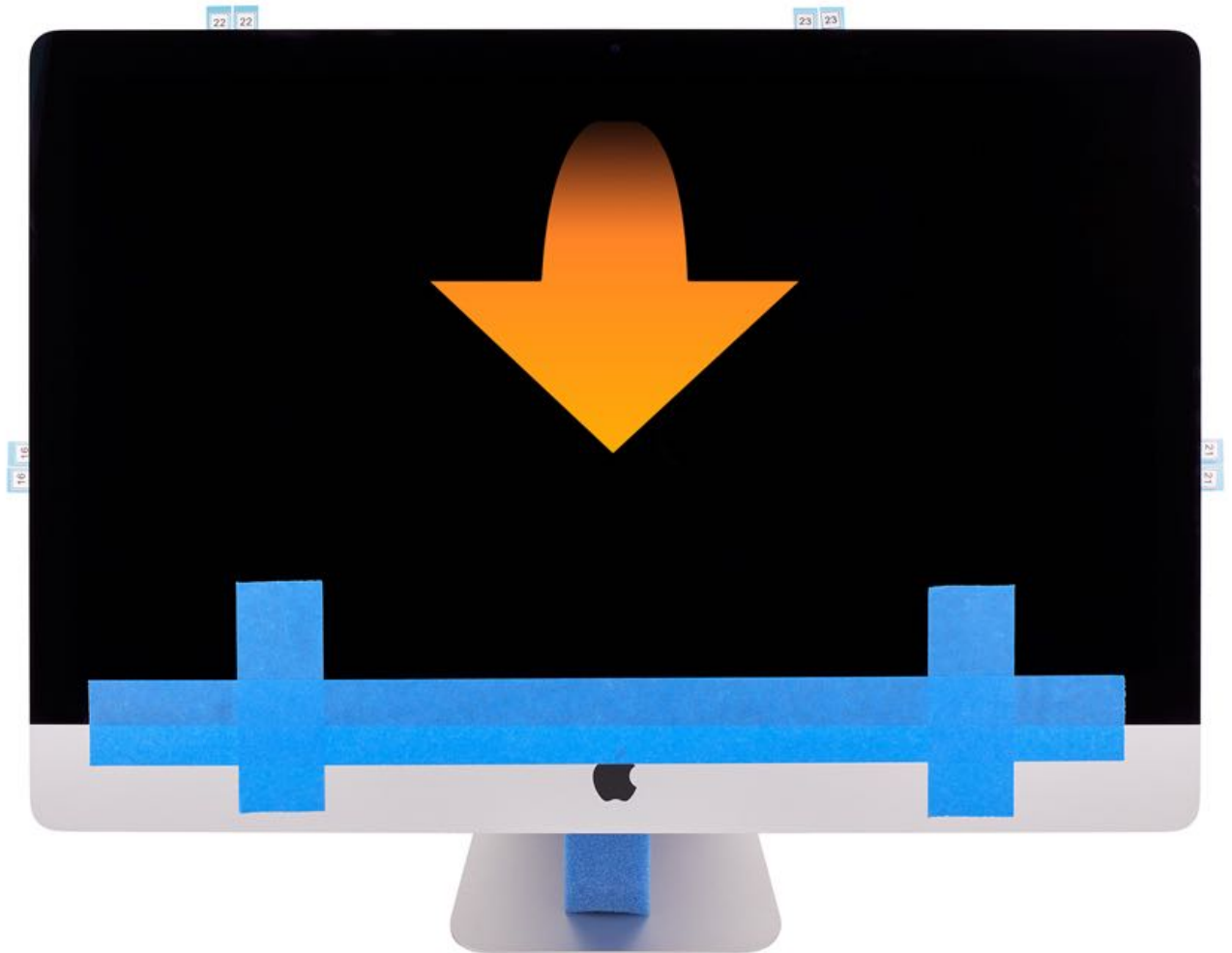
Incorrect alignment



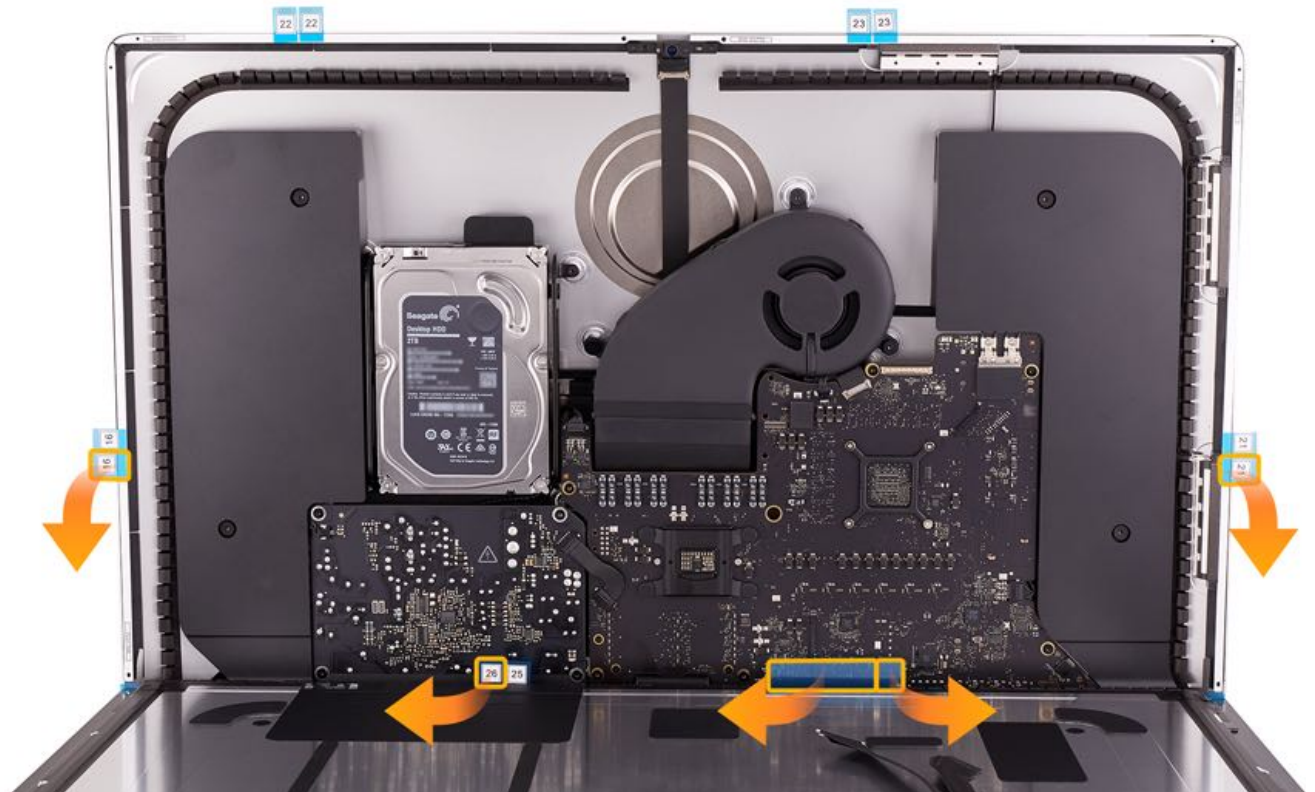
Correct alignment



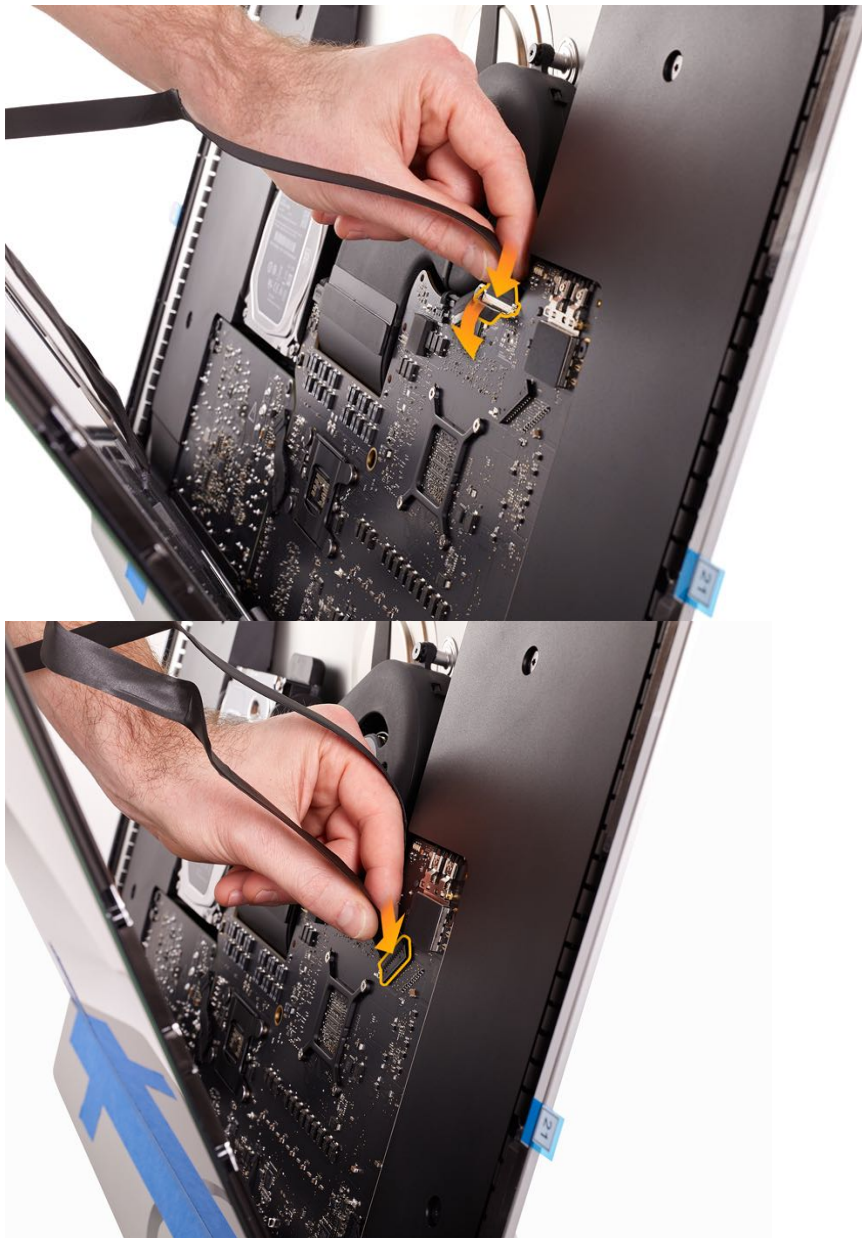
11. Anchor the display further with two vertical strips of painters tape. Use one hand to tilt the display down while steadying it with the other hand.



12. While continuing to steady the display with one hand, use the other hand to pull the clear release liners from the adhesive strips on the chin and bottom sides of the rear housing.
Note: Slowly pull the release liners so they do not tear or break.



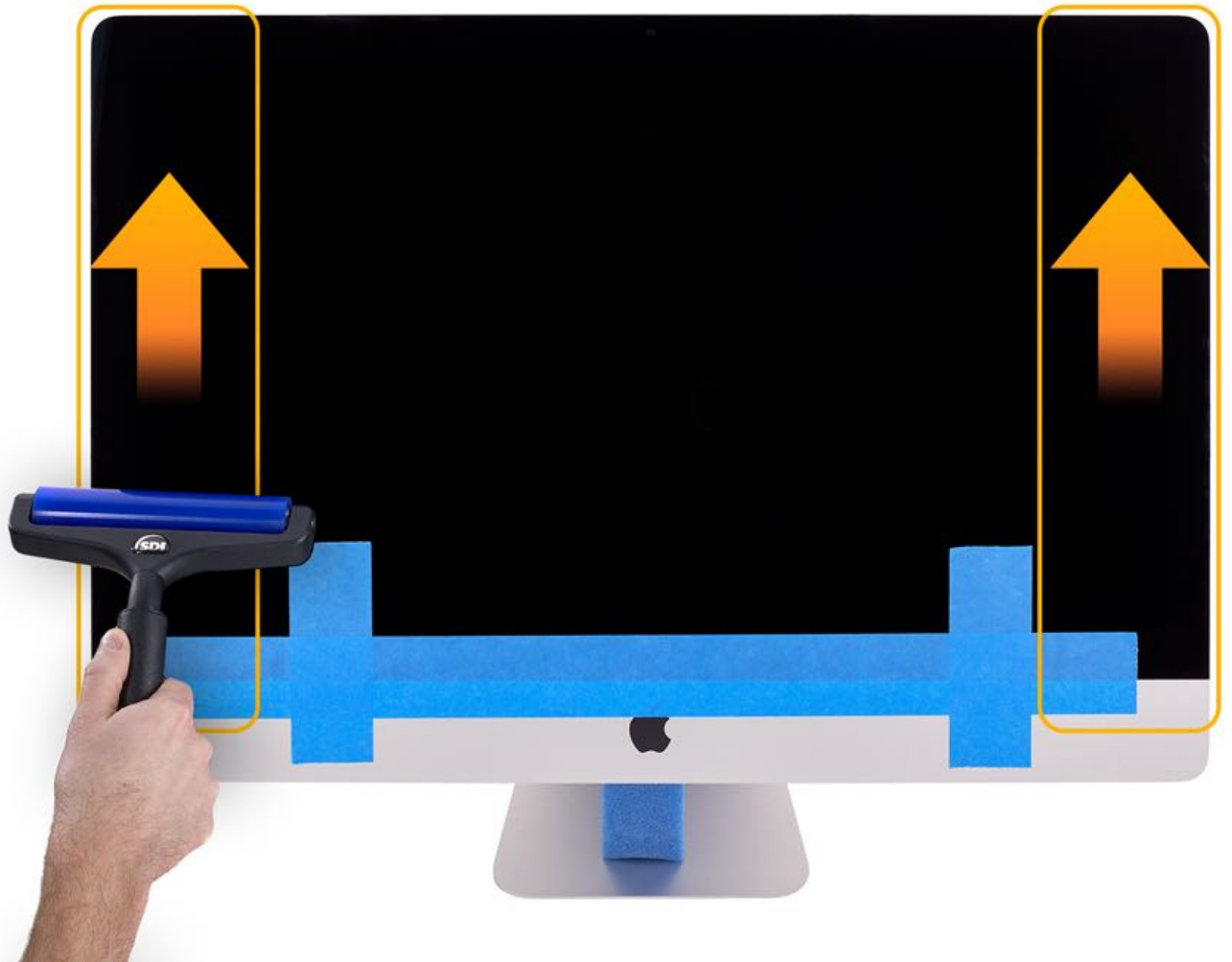
13. Tilt up the display, leaving enough room to connect the eDP cable and the display backlight power cable to the logic board. Check that the connectors are firmly seated.
Important: Do not stress the display cables and connectors on the logic board. If the connectors are damaged, you will need to replace the logic board.
Note: The display backlight power cable is part of the display assembly and is not available as a separate part.



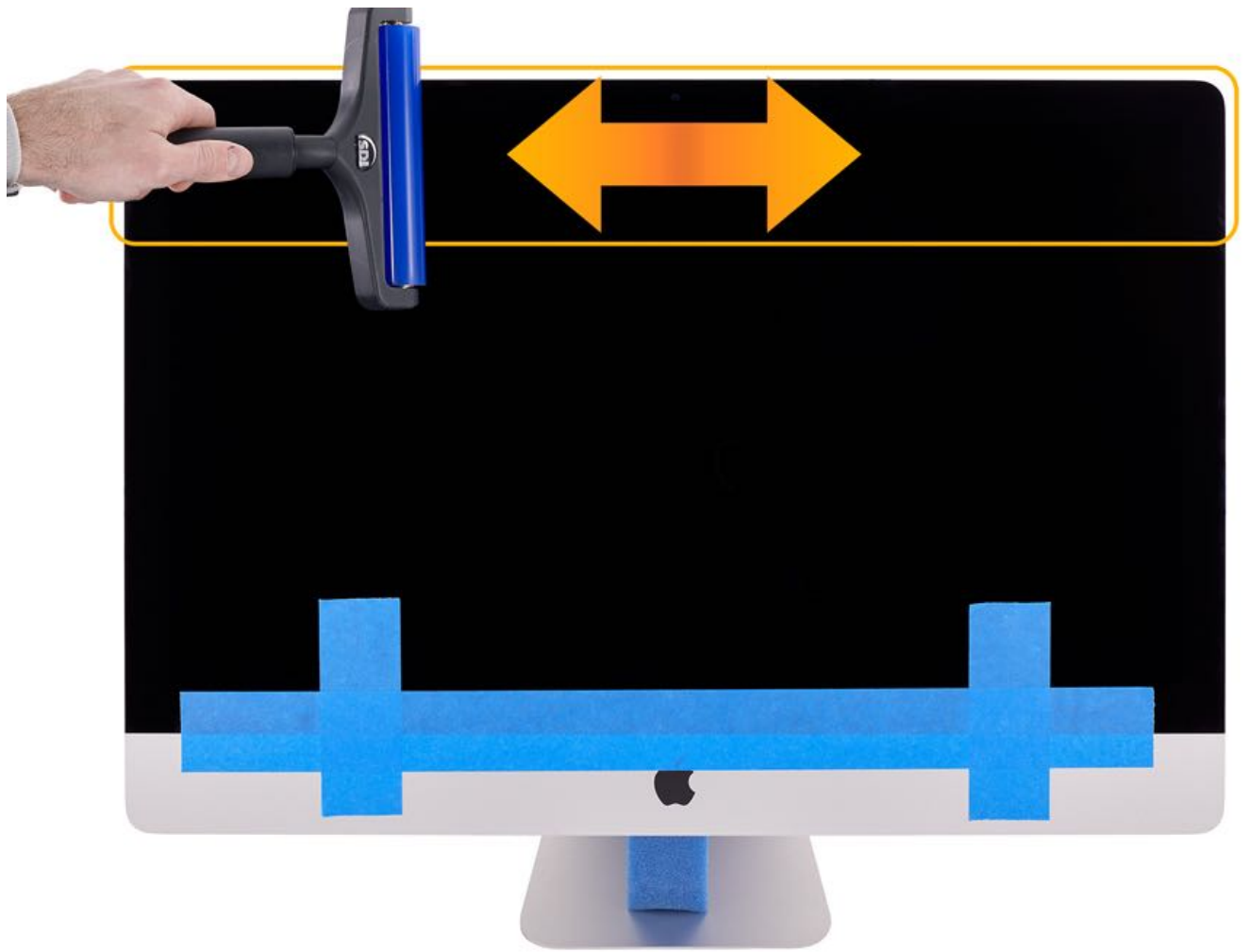
14. Remove the remaining release liners from the top and sides of the rear housing. After you've removed all the release liners, lean the display against the rear housing.



15. Use the silicone display roller to adhere the display adhesive strips to the glass. To prevent image quality issues, roll from the bottom up only.



16. Roll along the top in a horizontal back-and-forth motion.



17. Remove the painters tape and clean the front of the display with a clean, damp, lint-free cloth.
Note: Do not use IPA wipes to clean the display. Only use IPA wipes to remove any residual display adhesive.

iMac (2019) Embedded DisplayPort (eDP) Cable

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About AppleCare service certifications](#).



This procedure is shared between iMac (Retina 4K, 21.5-inch, 2019) and iMac (Retina 5K, 27-inch, 2019). Images in this shared procedure may show one model, but the steps to perform the repair are the same for both.

Remove:

- [Display](#)



Tools

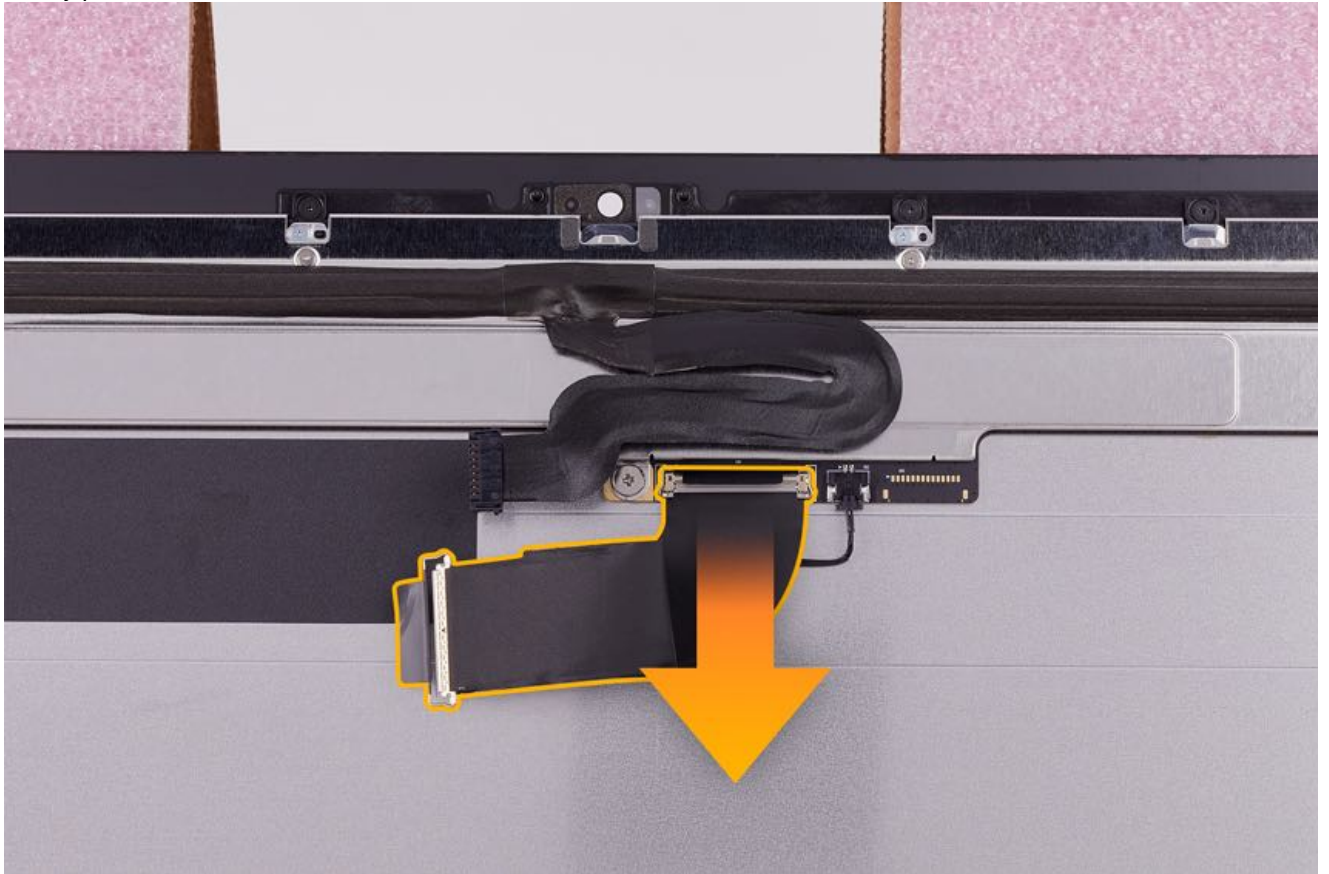
1. Black stick
2. iMac LCD service support stand (923-0416)



Steps For Removal

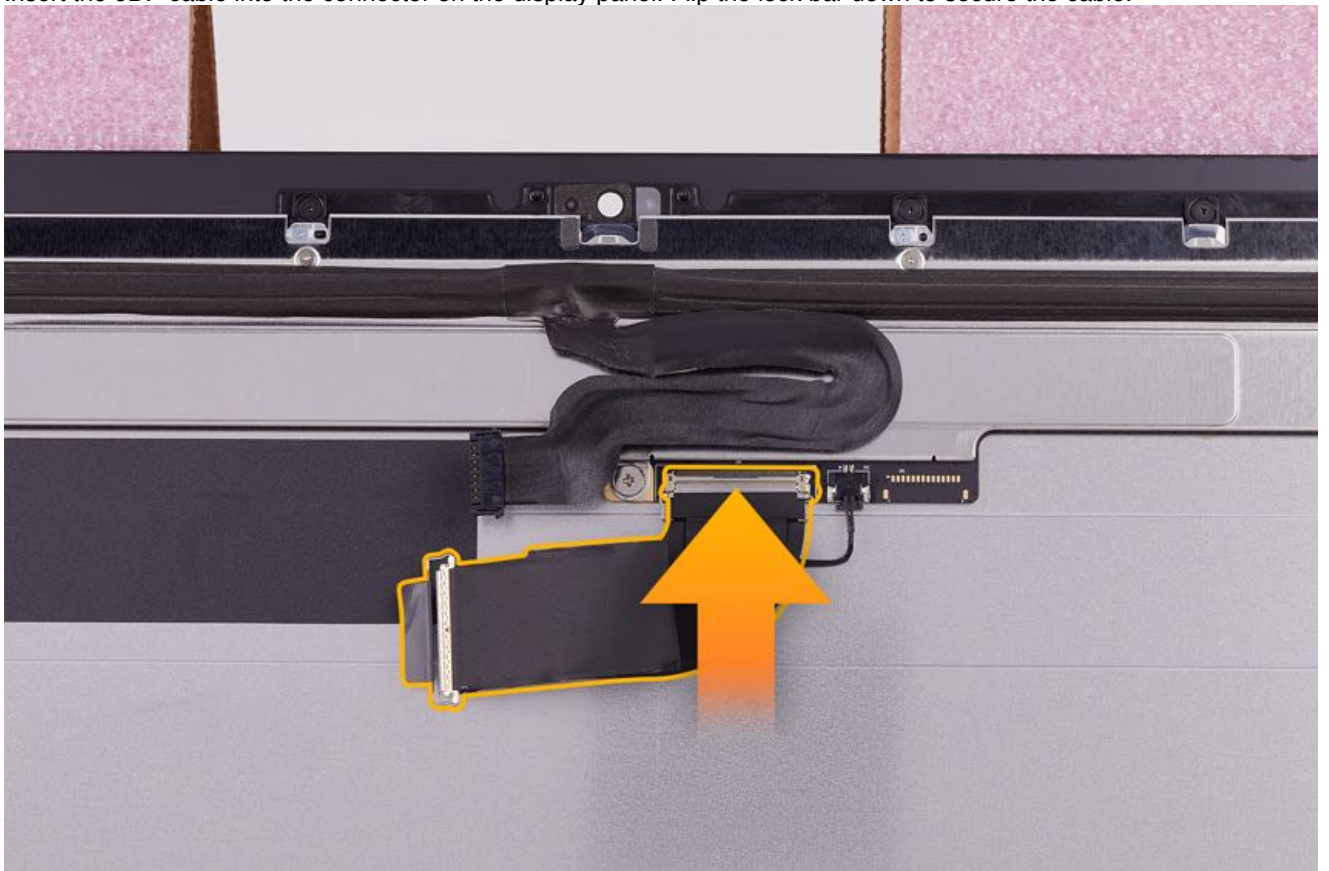
1. Remove any tape from the eDP cable that was securing it to the display.
2. Use a black stick to lift the pull tab on the eDP cable.
3. Use your fingers to pull back the pull tab, which will unlock the lock bar.

4. Gently pull the eDP cable out of the connector.



Steps For Reassembly

1. Insert the eDP cable into the connector on the display panel. Flip the lock bar down to secure the cable.



2. If any tape was present, reapply it to secure the cable to the display.
3. Reinstall the [display](#).

iMac (2019) Display Thermal Sensor Cable

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About AppleCare service certifications](#).

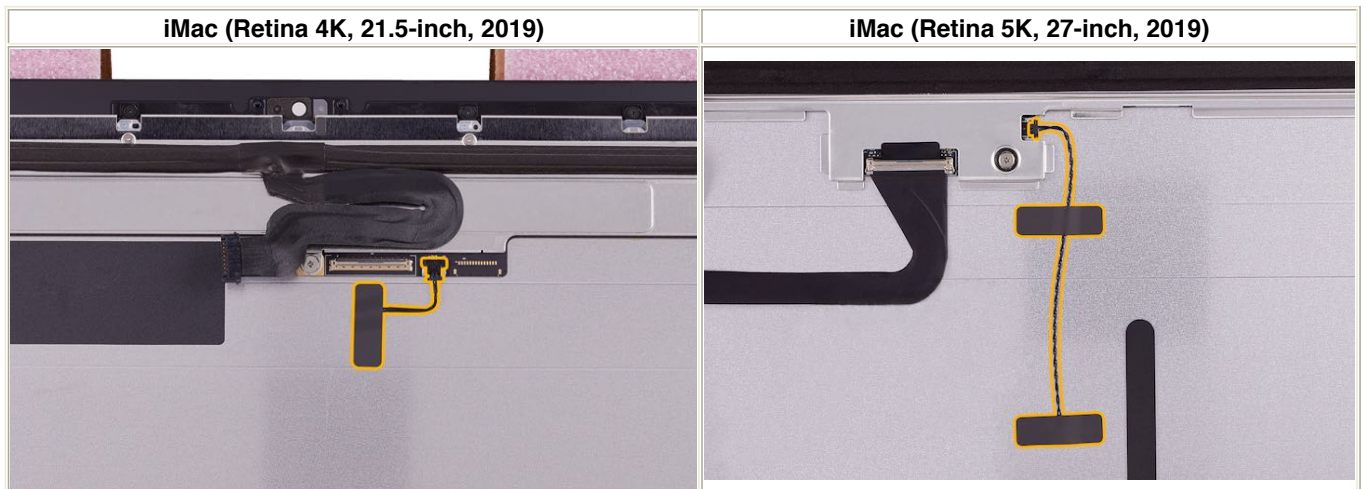


This procedure is shared between iMac (Retina 4K, 21.5-inch, 2019) and iMac (Retina 5K, 27-inch, 2019). Images in this shared procedure may show one model, but the steps to perform the repair are the same for both.

Note: Depending on the model being serviced, the thermal sensor cable placement is slightly different. Refer to the two images below.

Remove:

- [Display](#)



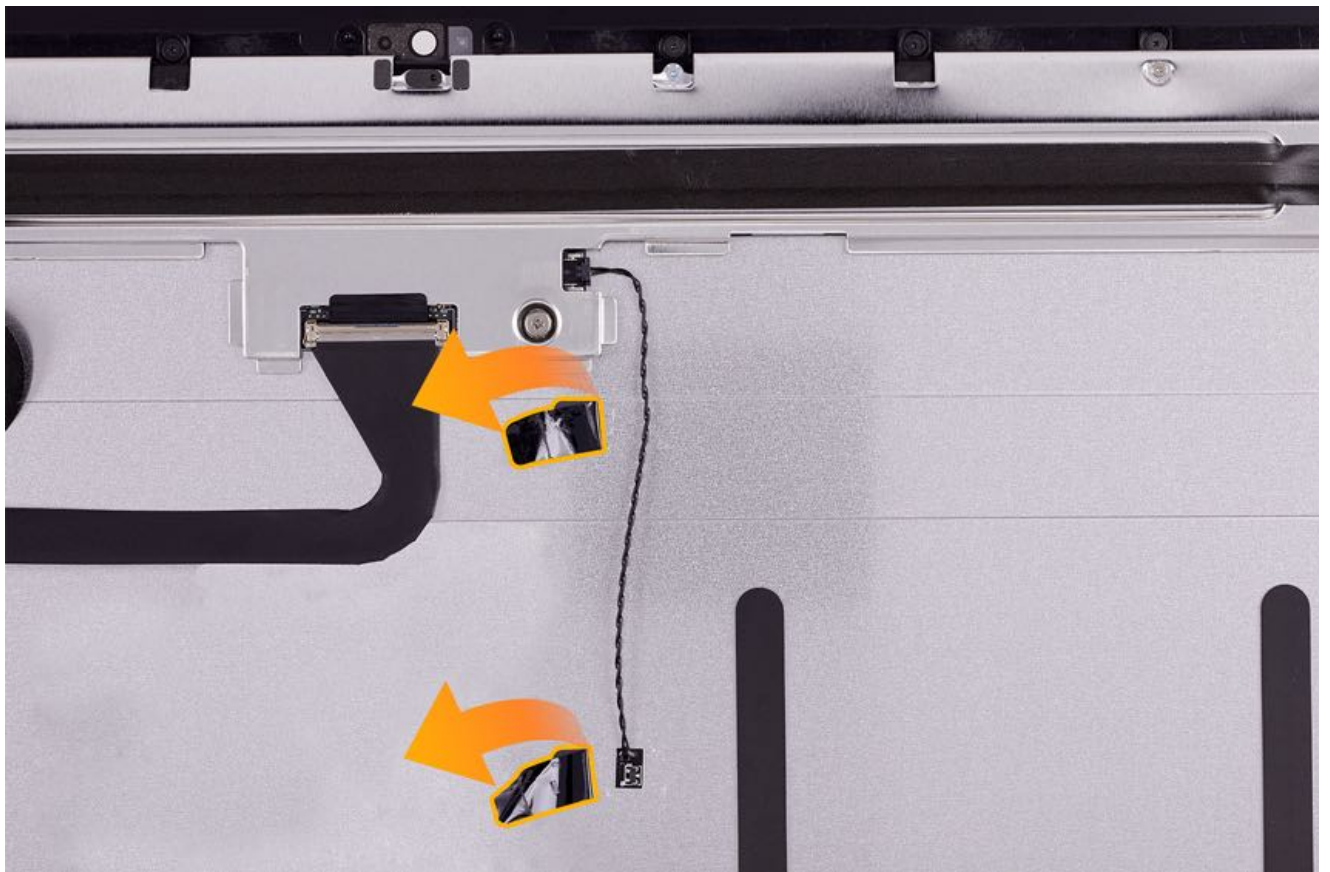
Tools

1. Black stick
2. iMac LCD service support stand (923-0416)

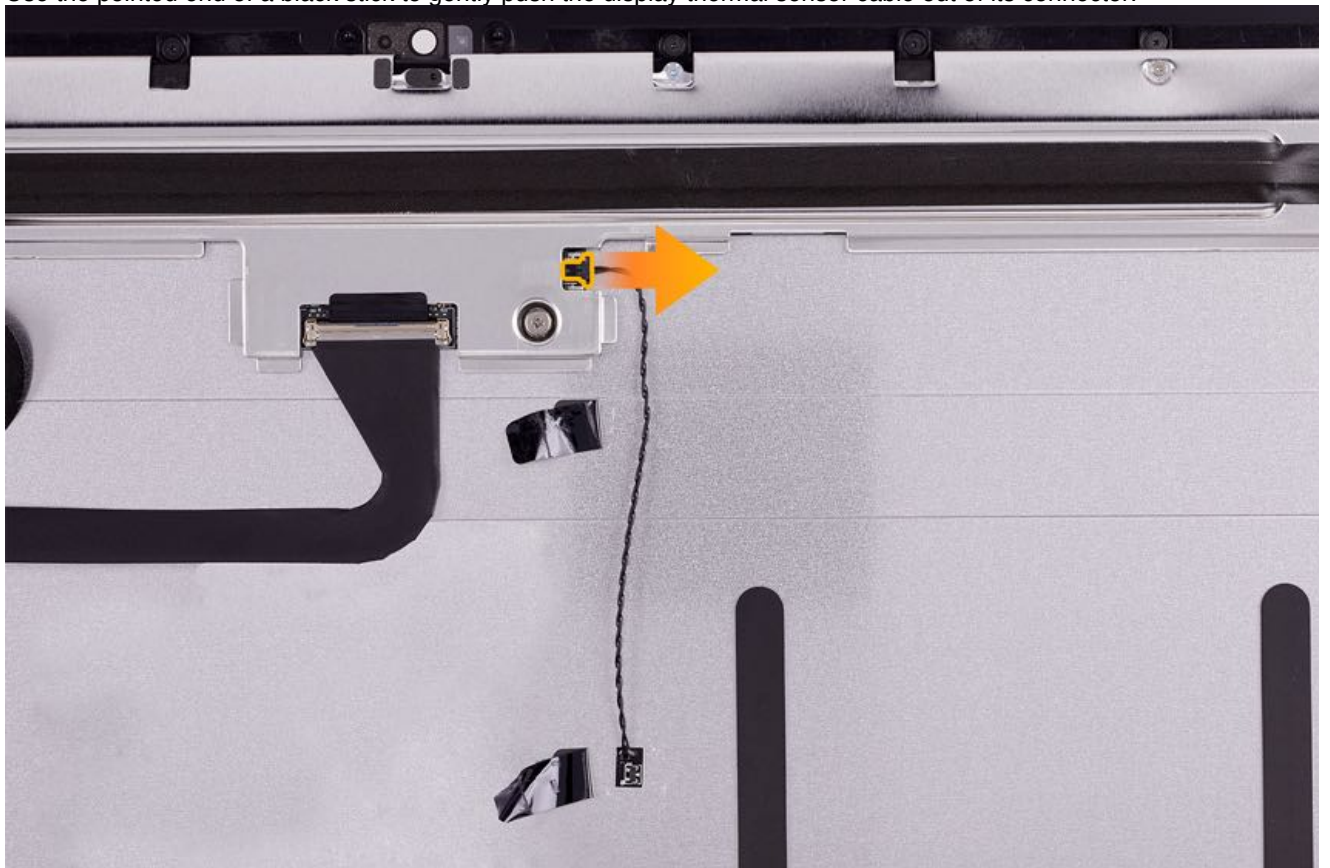


Steps For Removal

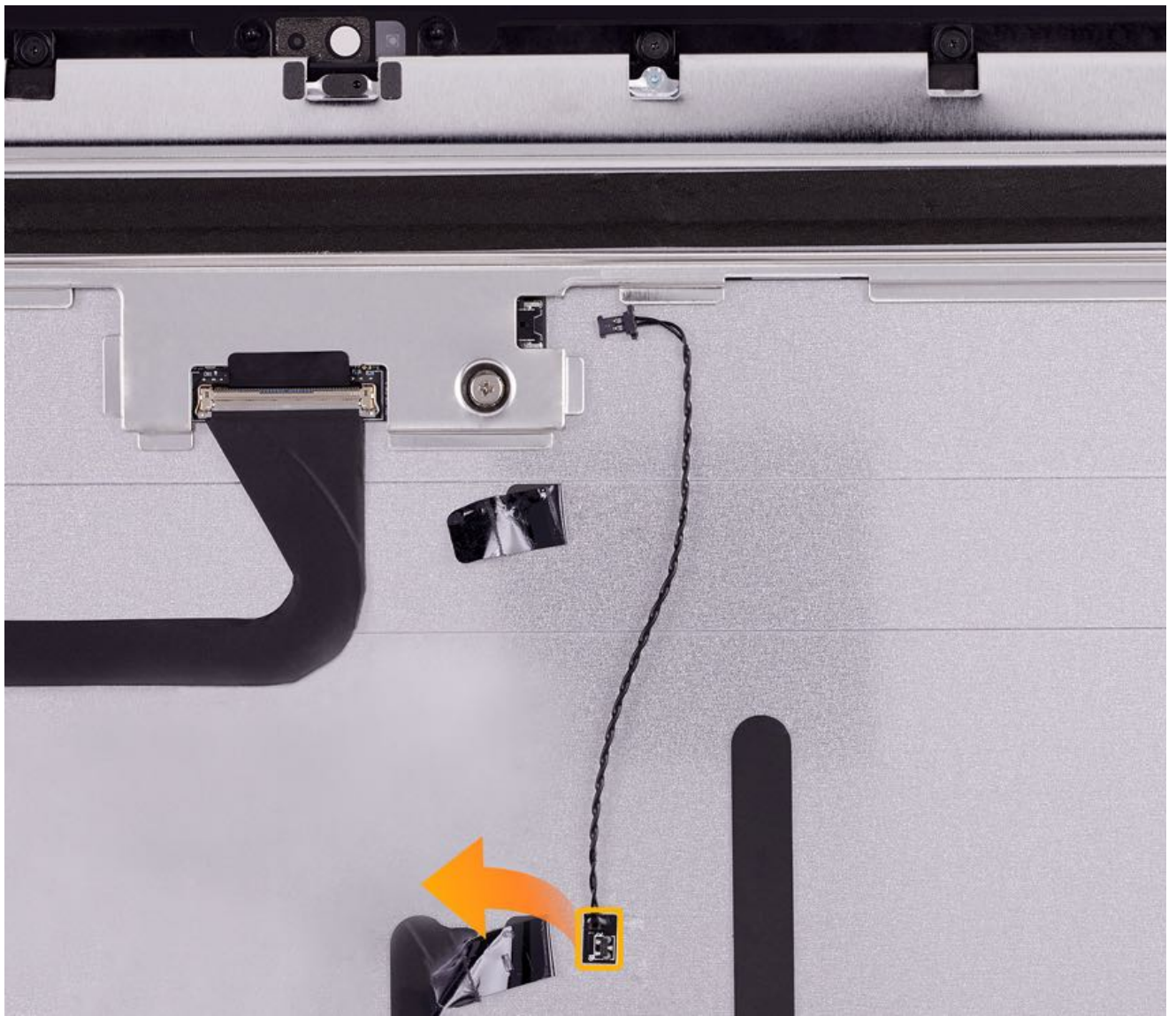
1. Remove any tape that secures the display thermal sensor cable to the display panel.



2. Use the pointed end of a black stick to gently push the display thermal sensor cable out of its connector.



3. Use a black stick to peel off the square sensor board from the display panel.

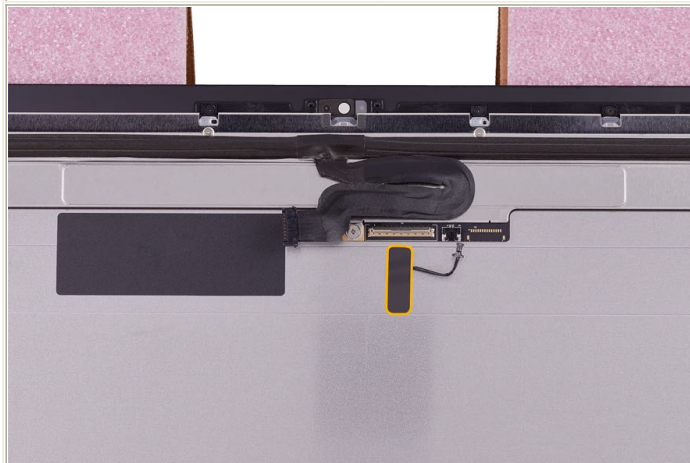


Steps For Reassembly

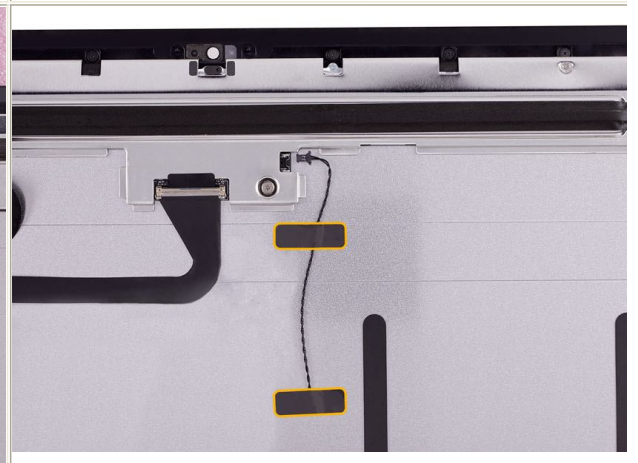
Steps for Reassembly

1. Remove the adhesive backing from the replacement square sensor board and stick the adhesive side down on the display panel.
2. Secure the cable to the display panel with tape.

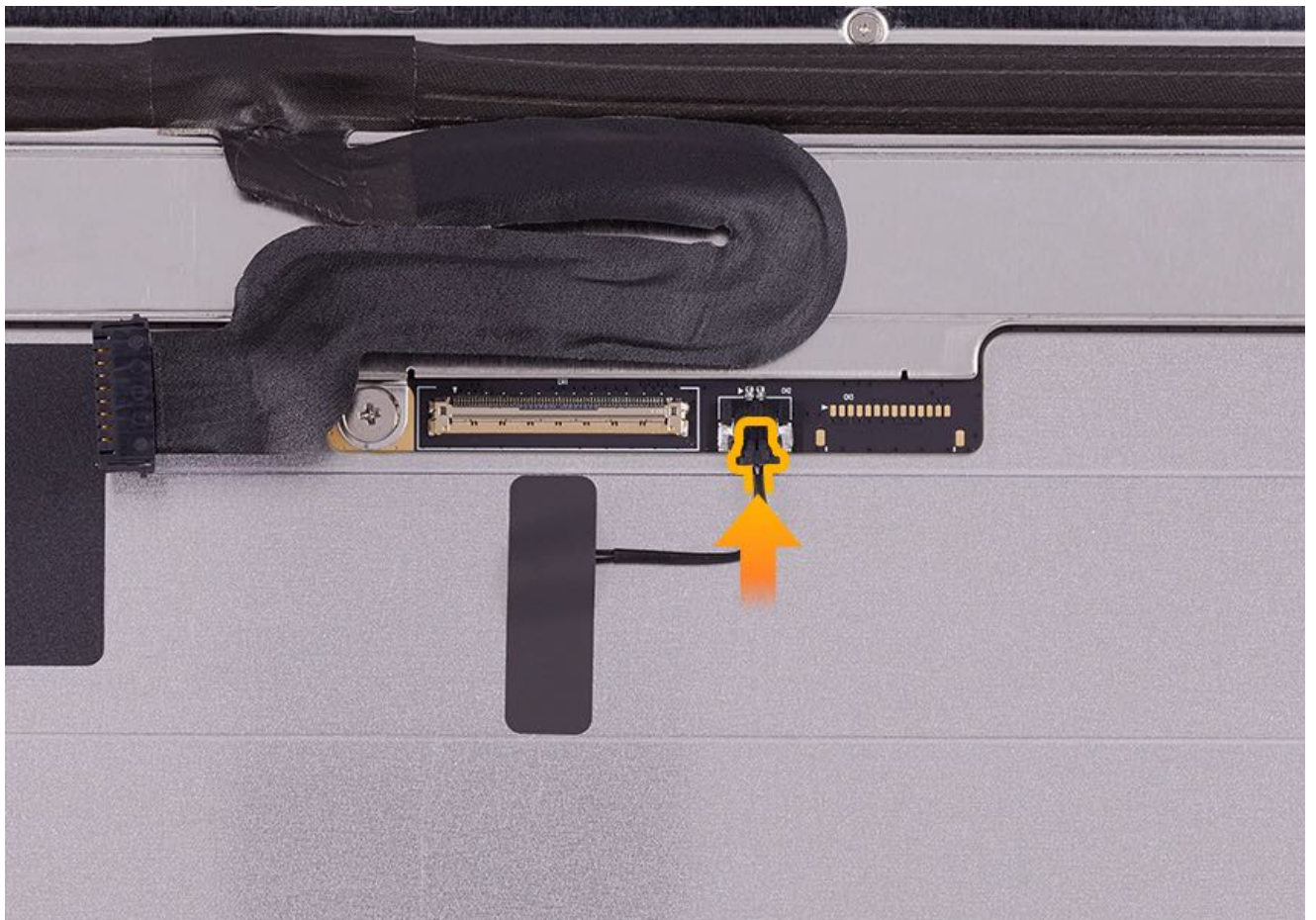
iMac (Retina 4K, 21.5-inch, 2019)



iMac (Retina 5K, 27-inch, 2019)



3. Insert the cable into its connector.



4. Reinstall the [display](#) to complete reassembly.

iMac (2019) Camera

First Steps

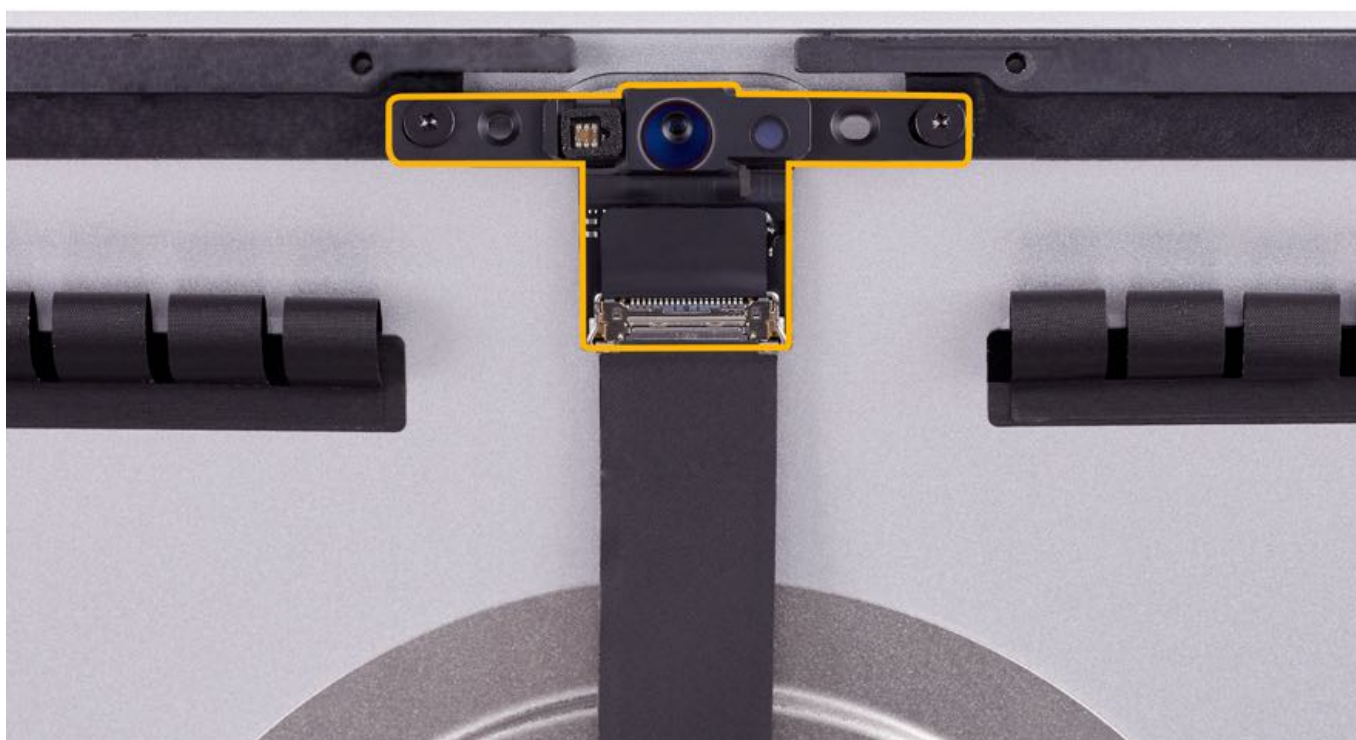
Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).



This procedure is shared between iMac (Retina 4K, 21.5-inch, 2019) and iMac (Retina 5K, 27-inch, 2019). Images in this shared procedure may show one model, but the steps to perform the repair are the same for both.

Remove:

- [Display](#)



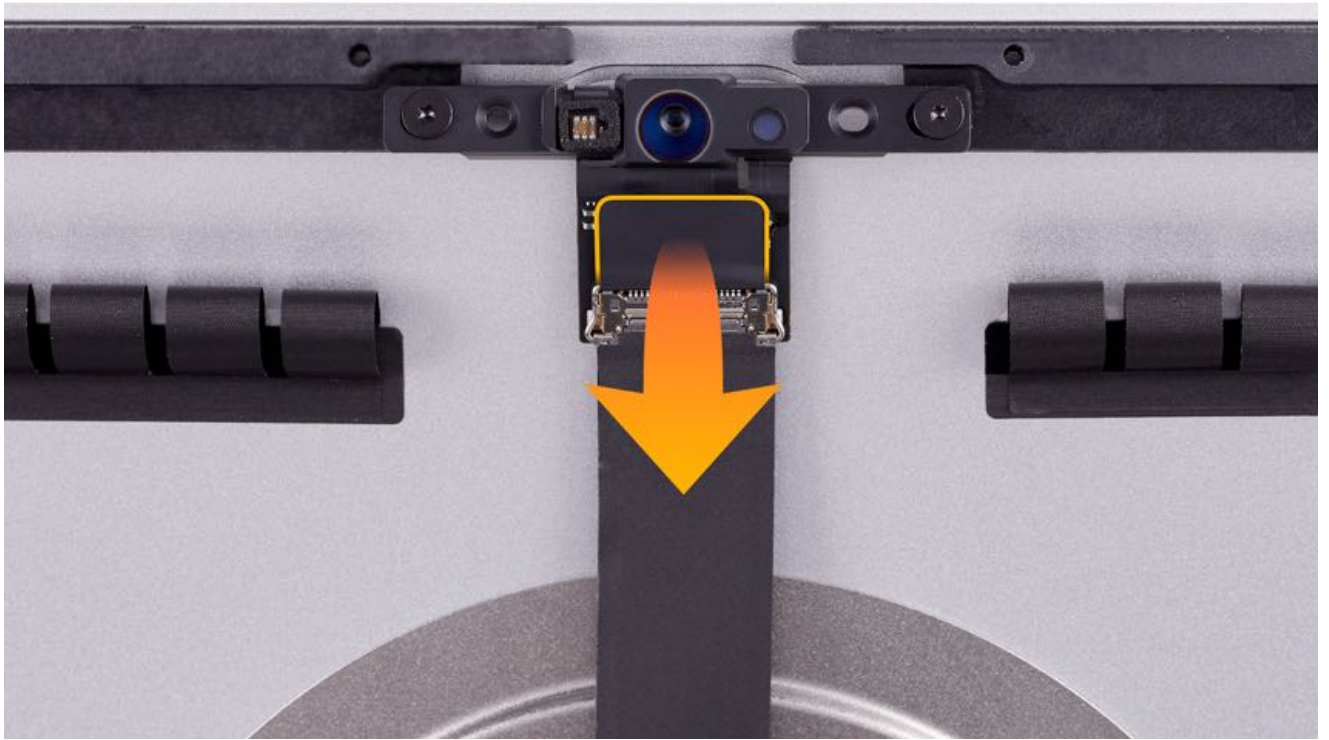
Tools

1. Black stick
2. iMac service wedge
3. Torx T5 screwdriver

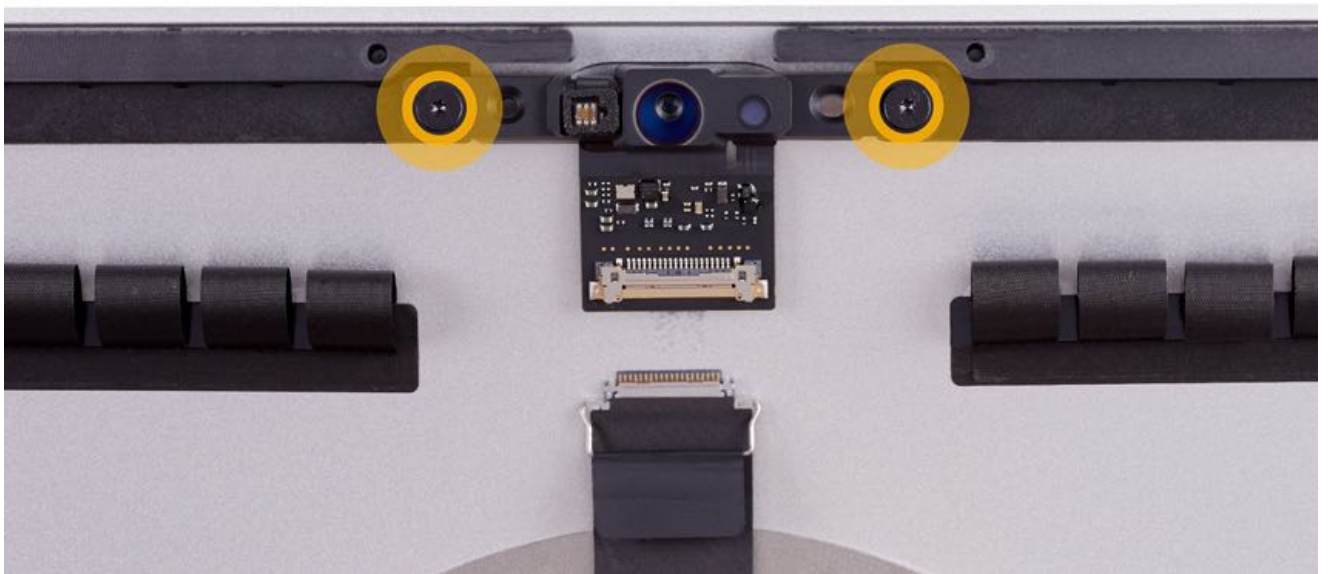


Steps For Removal

1. Use a black stick to flip the lock bar on the camera cable. Pull the camera cable straight out from the connector on the camera board.



2. Remove two T5 screws from the camera board.



3. If the camera cable needs to be removed, then use a black stick to flip the lock bar on the camera cable. Pull the camera cable straight out from the connector on the logic board.
Note: For iMac (Retina 5K, 27-inch, 2019) you will need to remove the [fan](#) in order to access the camera cable.



Steps For Reassembly

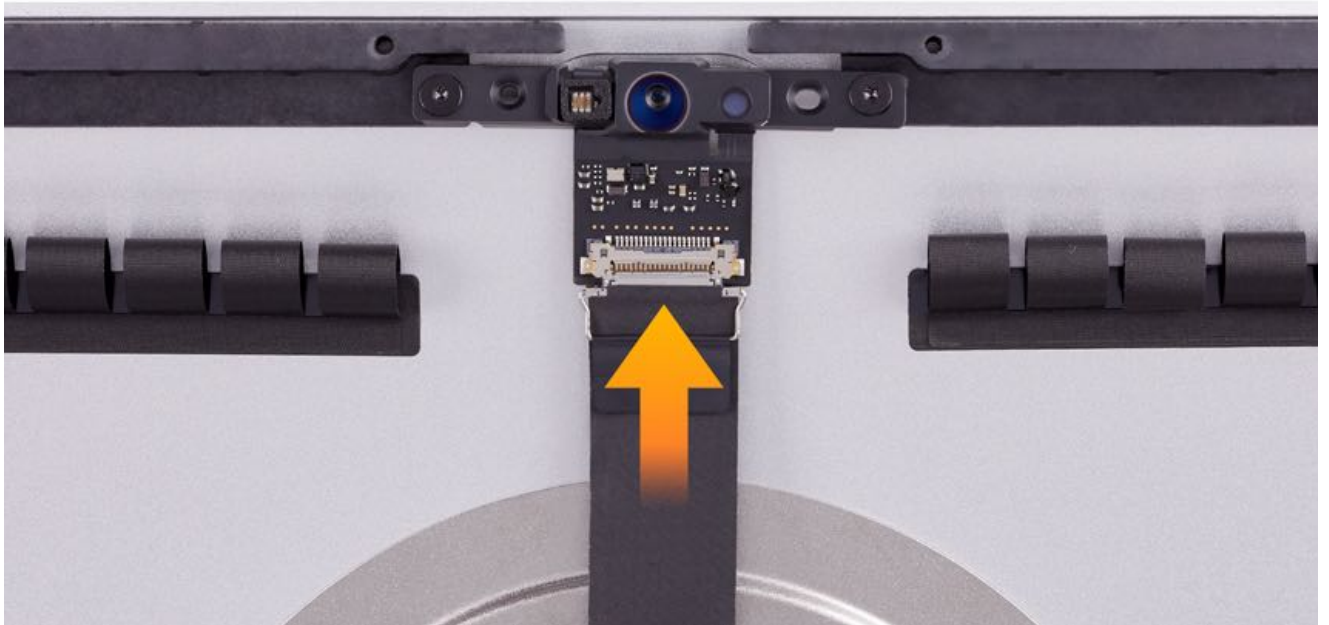
1. Reinstall the two T5 screws in the camera board.

Note: If installing a replacement camera, remove the protective film covering the lens.

- 923-0339

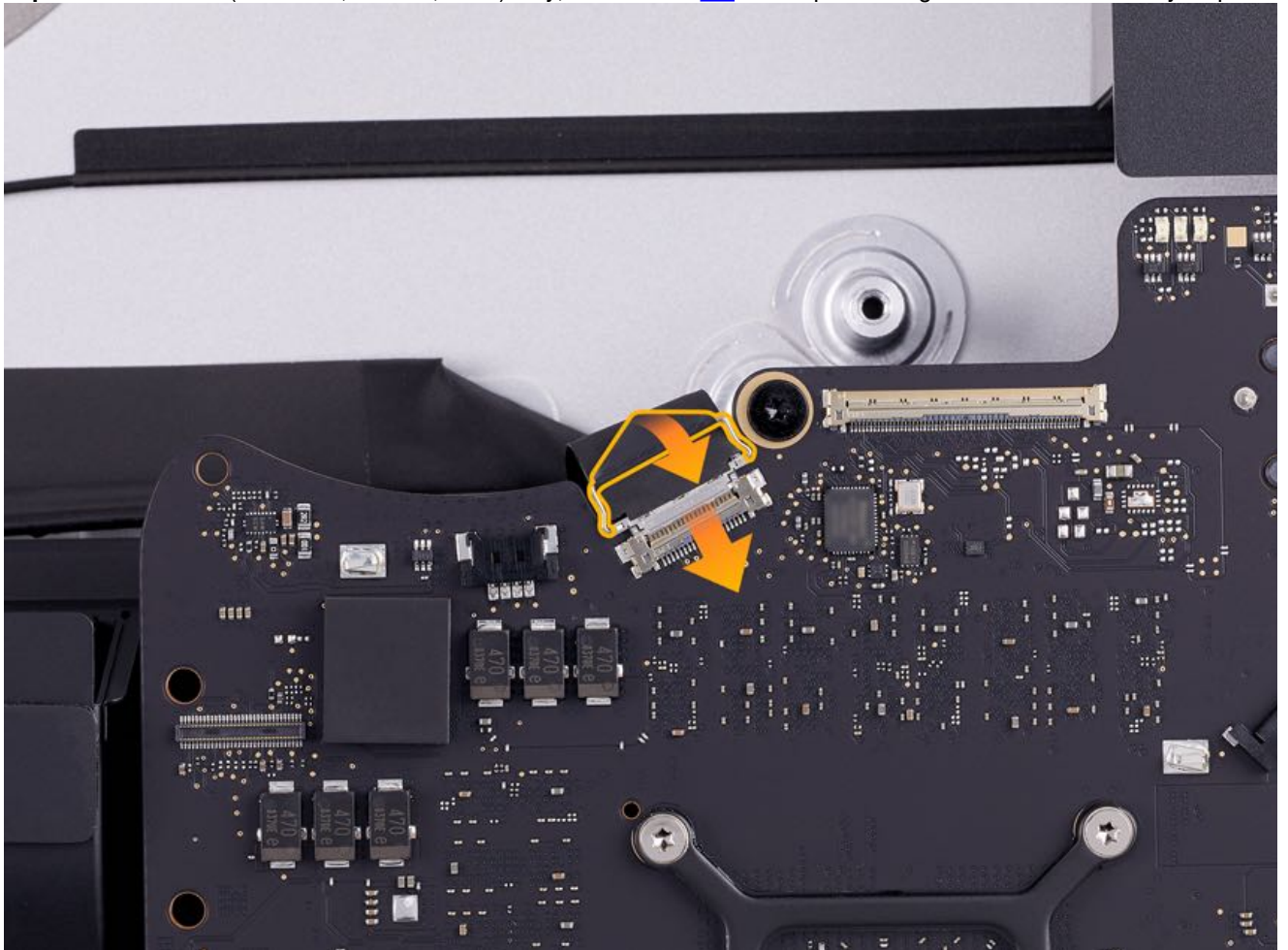


2. Connect the camera cable to the camera board connector. Flip the lock bar closed to secure the cable.



3. If the camera cable was replaced, then connect the camera cable to the logic board connector. Flip the lock bar closed to secure the cable.

Important: For iMac (Retina 5K, 27-inch, 2019) only, reinstall the [fan](#) before proceeding to the next reassembly step.



4. Reinstall the [display](#) to complete reassembly.

iMac (Retina 5K, 27-inch, 2019) Fan

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

Remove:

- [Display](#)



Tools

1. Black stick
2. iMac service wedge
3. Torx T10 screwdriver

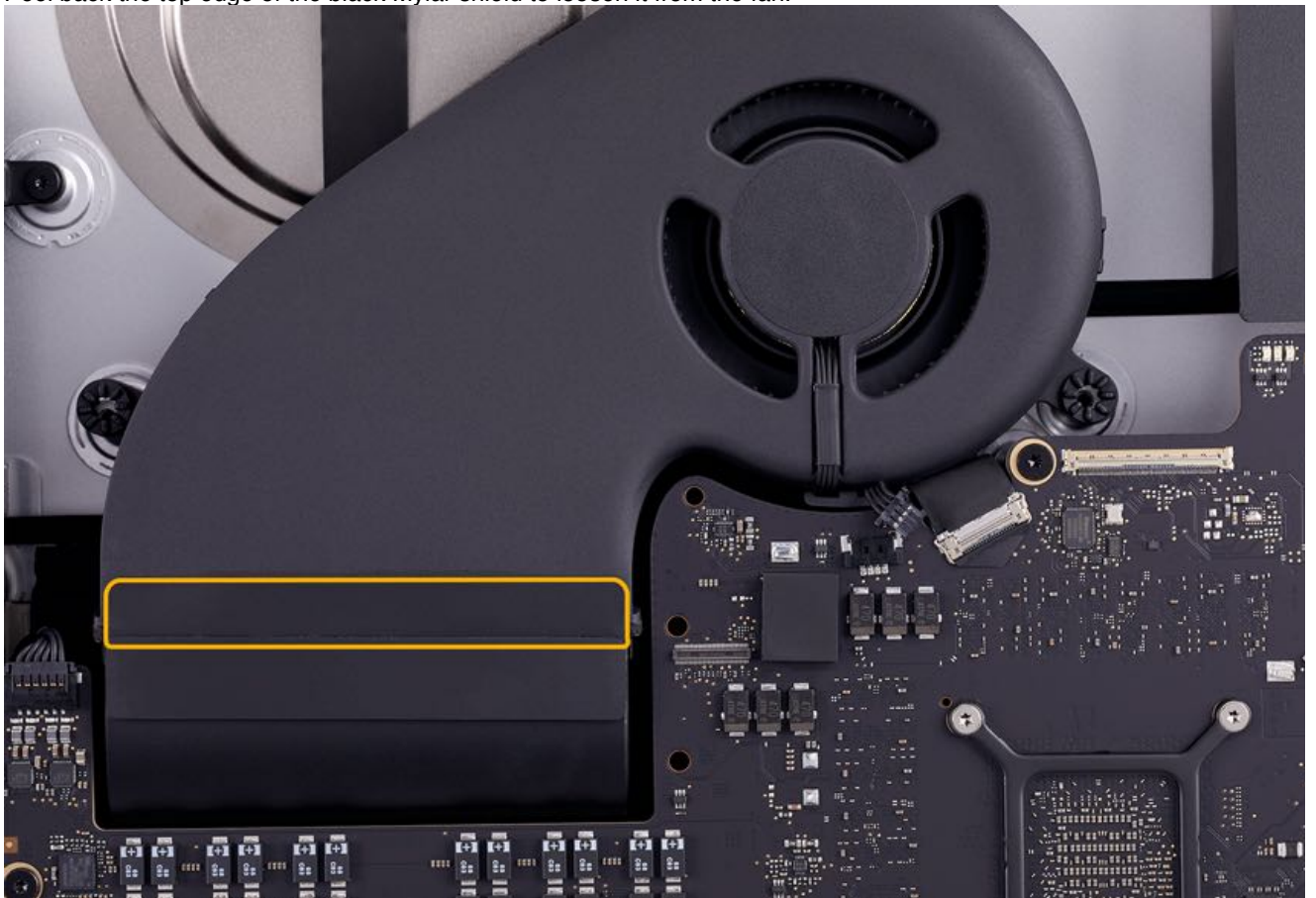


Steps For Removal

1. Use a black stick to disconnect the fan cable from the logic board.
2. Remove three T10 screws from the fan.

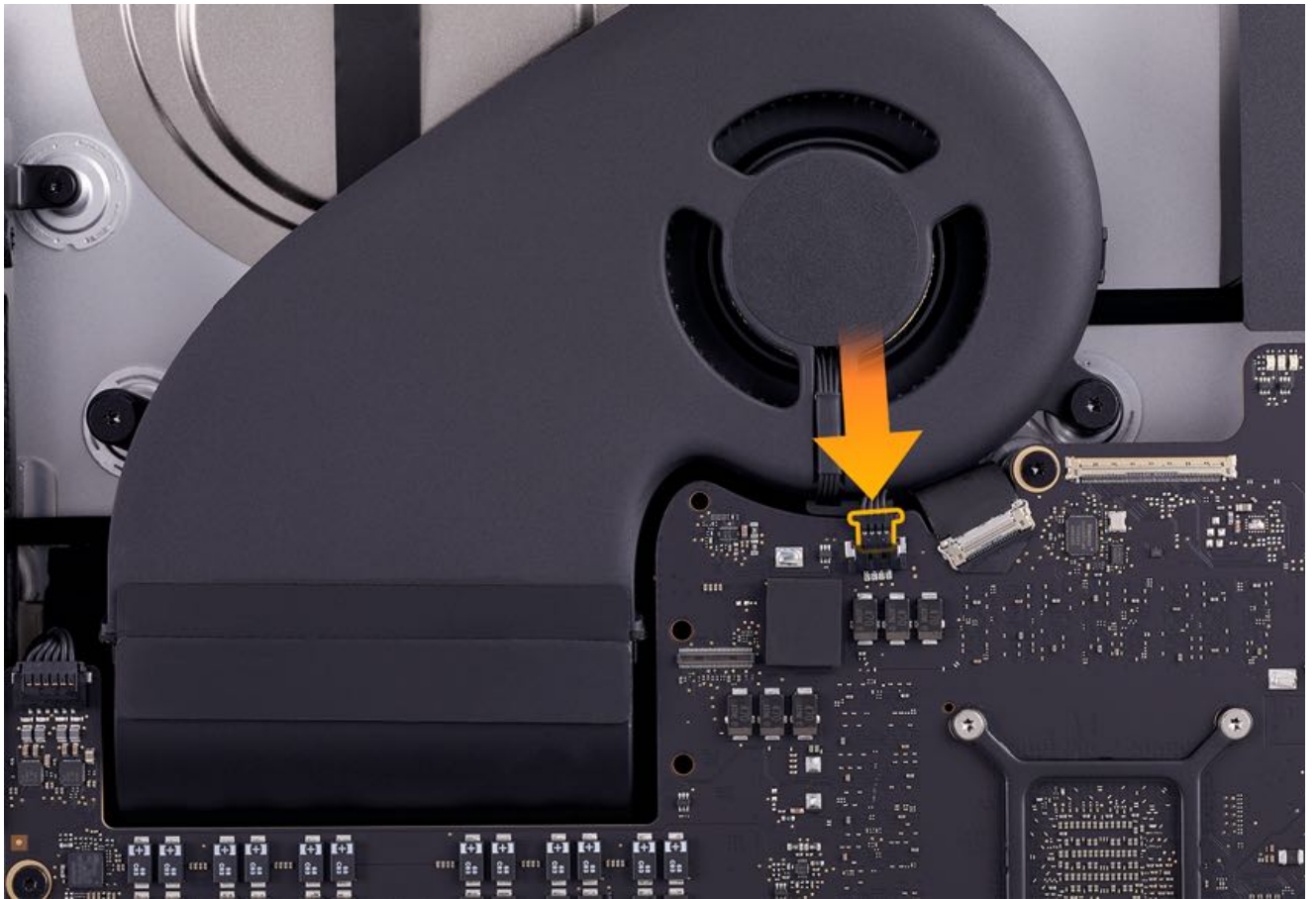


3. Peel back the top edge of the black Mylar shield to loosen it from the fan.

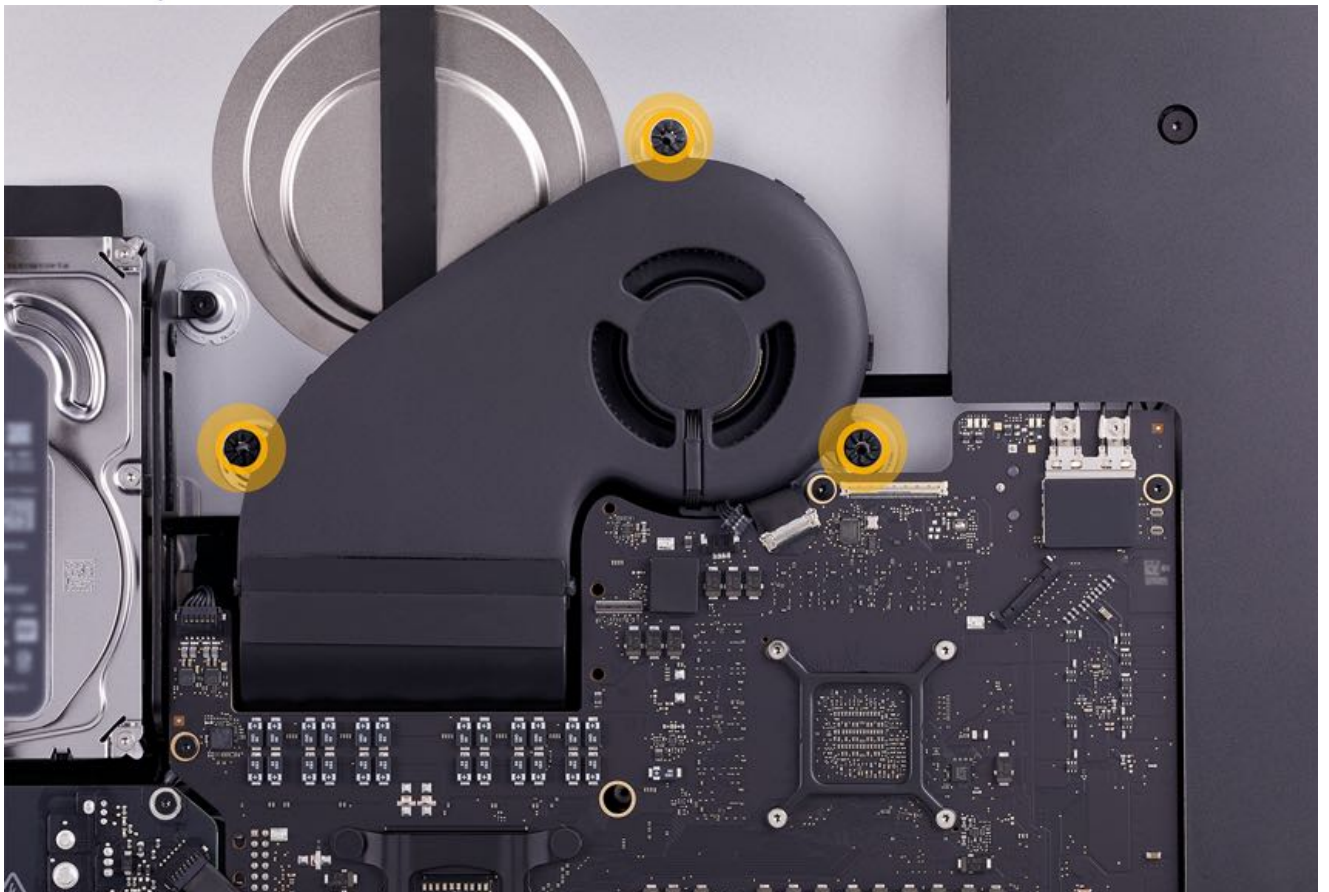


Steps For Reassembly

1. Connect the fan cable to the logic board.



2. Reinstall three T10 screws (923-00669) in the fan.



3. Reinstall the [display](#) to complete reassembly.

iMac (Retina 5K, 27-inch, 2019) Left Speaker

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

Remove:

- [Display](#)

Important: Speakers must be replaced in pairs. If you replace the left speaker, then you must also replace the [right speaker](#).



Tools

1. Black stick
2. Phillips #00 screwdriver
3. Torx T10 screwdriver
4. iMac service wedge
5. Sticky notes



Steps For Removal

1. Remove nine Phillips #00 screws from the chin.



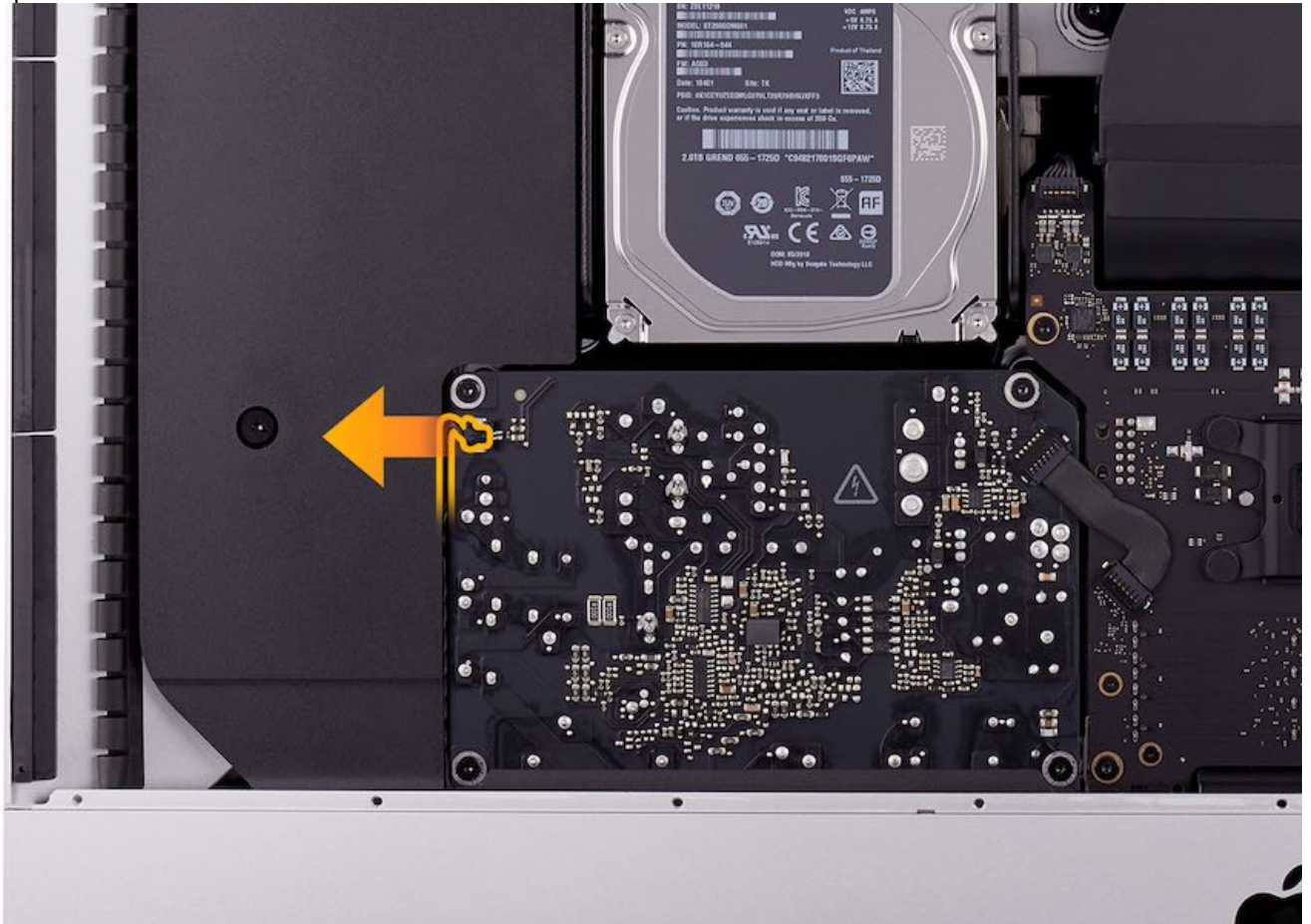
2. Remove the chin strap and set aside for reuse.
Important: Be careful not to bend the chin strap.



3. Disconnect the power button cable from the power supply.



Caution: The power button cable is part of the rear housing. If the cable breaks, the rear housing will need to be replaced.



4. Completely unscrew two T10 screws from the speaker.

Note: The screws tighten into rubber grommets and may remain in the screw holes when the speaker is removed.

4.

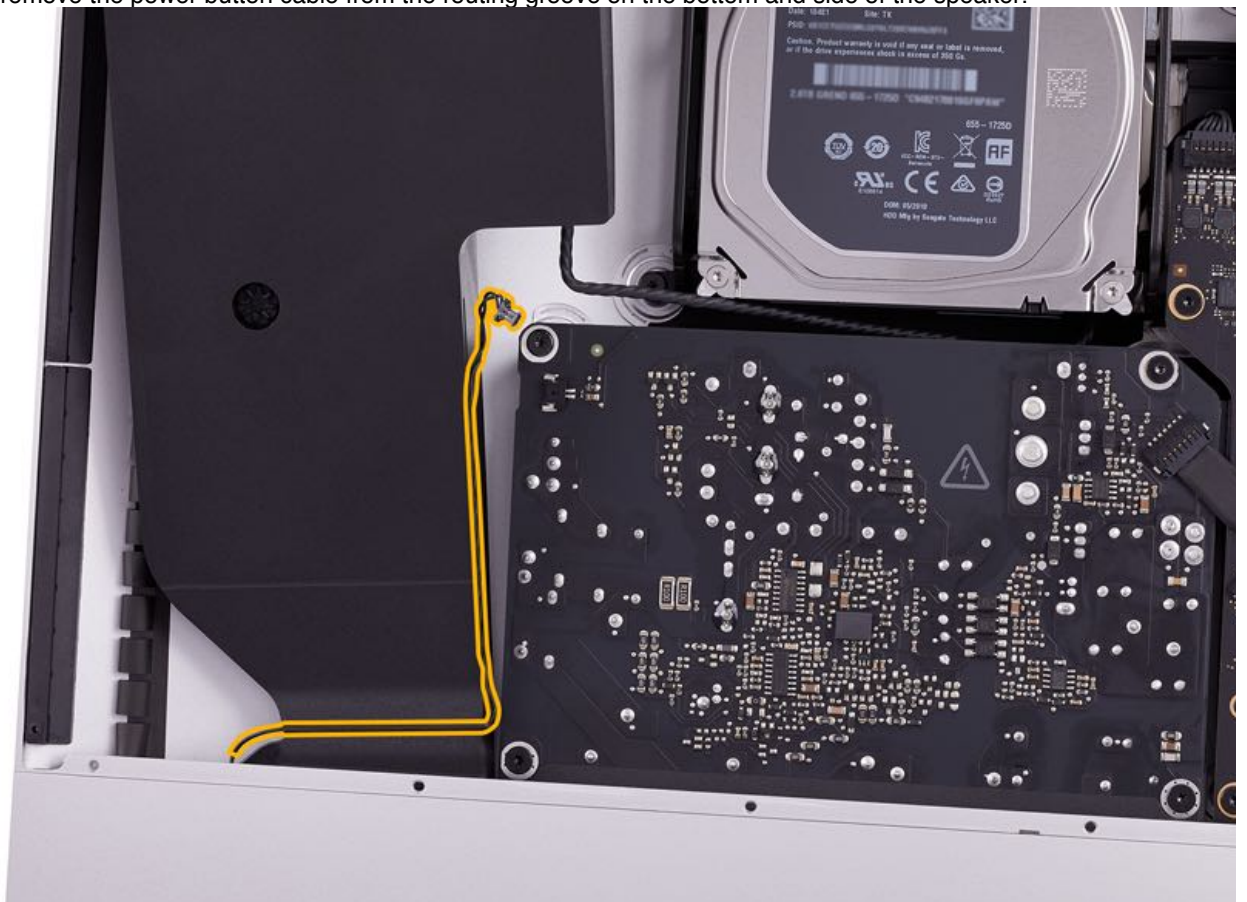


Caution: The power button cable is routed in a groove on the speaker. Use care when handling the speaker to avoid damaging the power button cable. If the cable breaks, the rear housing will need to be replaced.

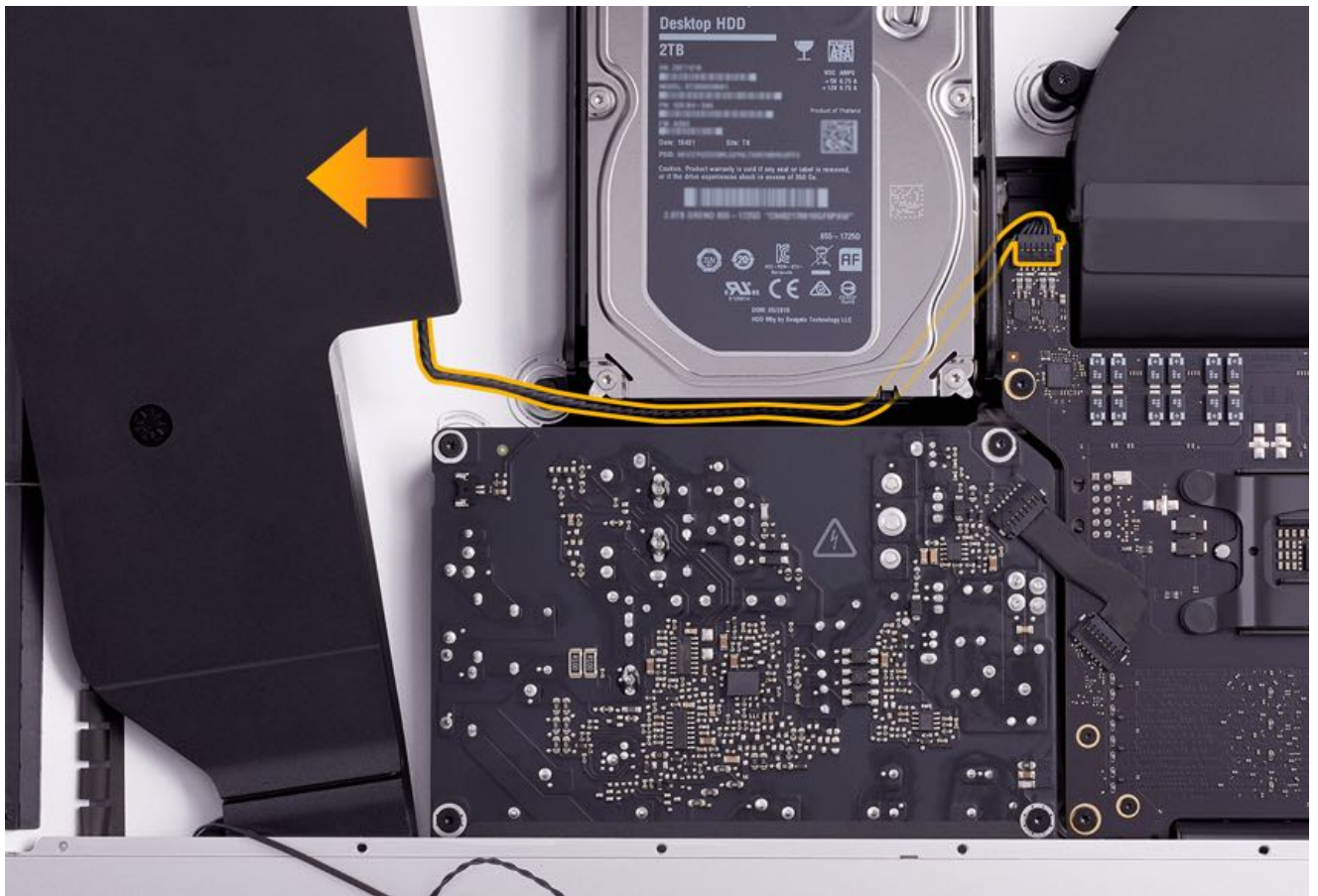
5. Tilt the speaker slightly forward (1) then lift (2) until the power button cable is visible.



6. Gently remove the power button cable from the routing groove on the bottom and side of the speaker.



7. Tilt the speaker to the left. Disconnect the speaker cable from the logic board. Gently pull the speaker cable from under the hard drive and the right hard drive bracket. Lift the speaker out of the rear housing.



Steps For Reassembly

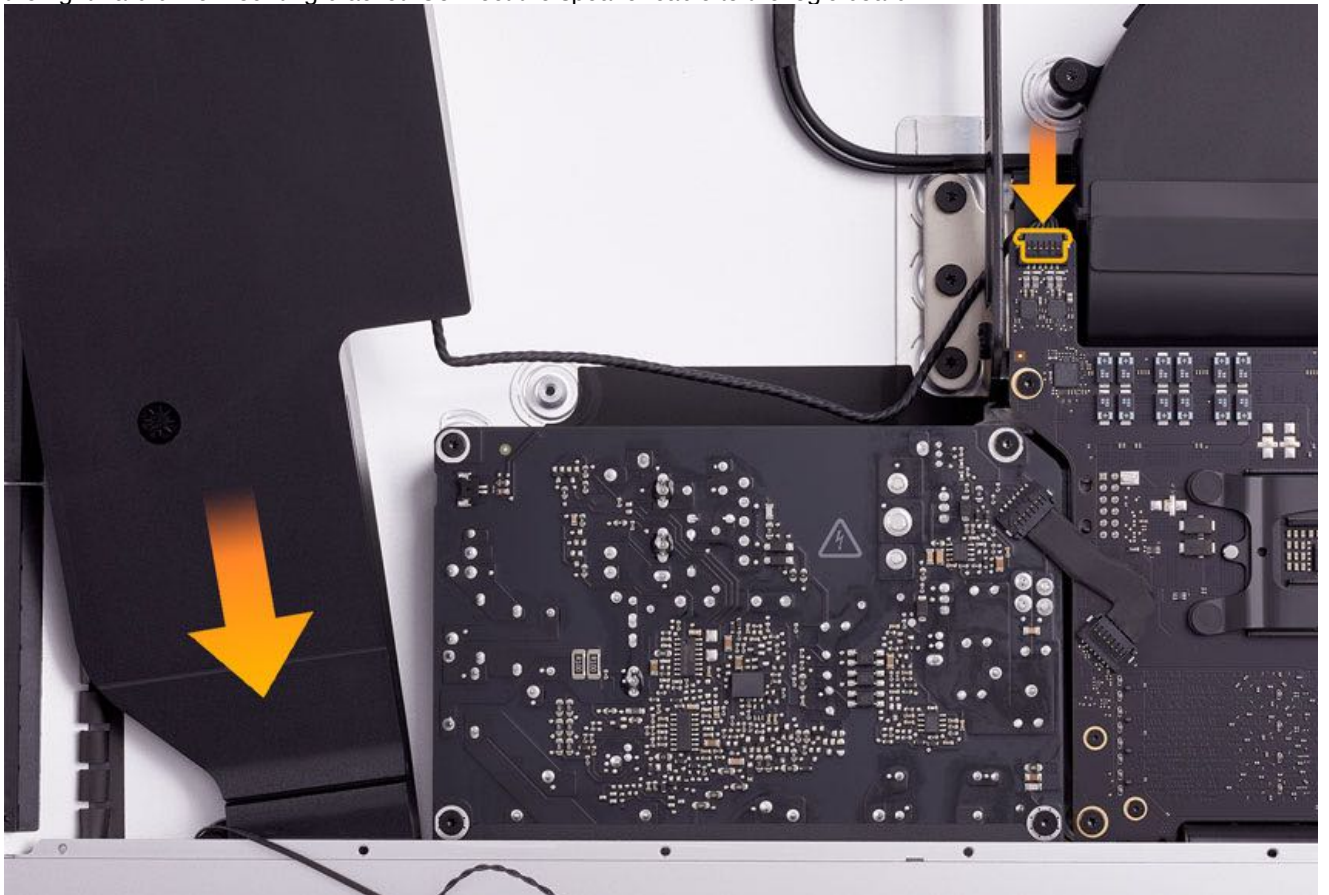
1. Support the hard drive with one hand. Remove two T8 screws from the left hard drive mounting bracket. Remove the bracket.



2. Disconnect the data and power cable from the top of the hard drive. Slide the hard drive out of the right mounting bracket. Remove the hard drive.



3. Position the speaker in the rear housing. Route the speaker cable along the top edge of the power supply and under the right hard drive mounting bracket. Connect the speaker cable to the logic board.



4. Route the power button cable in the groove on the bottom and side of the speaker.
Important: Ensure that the power button cable does not bind or slip out of the routing groove as you place the speaker into the rear housing.



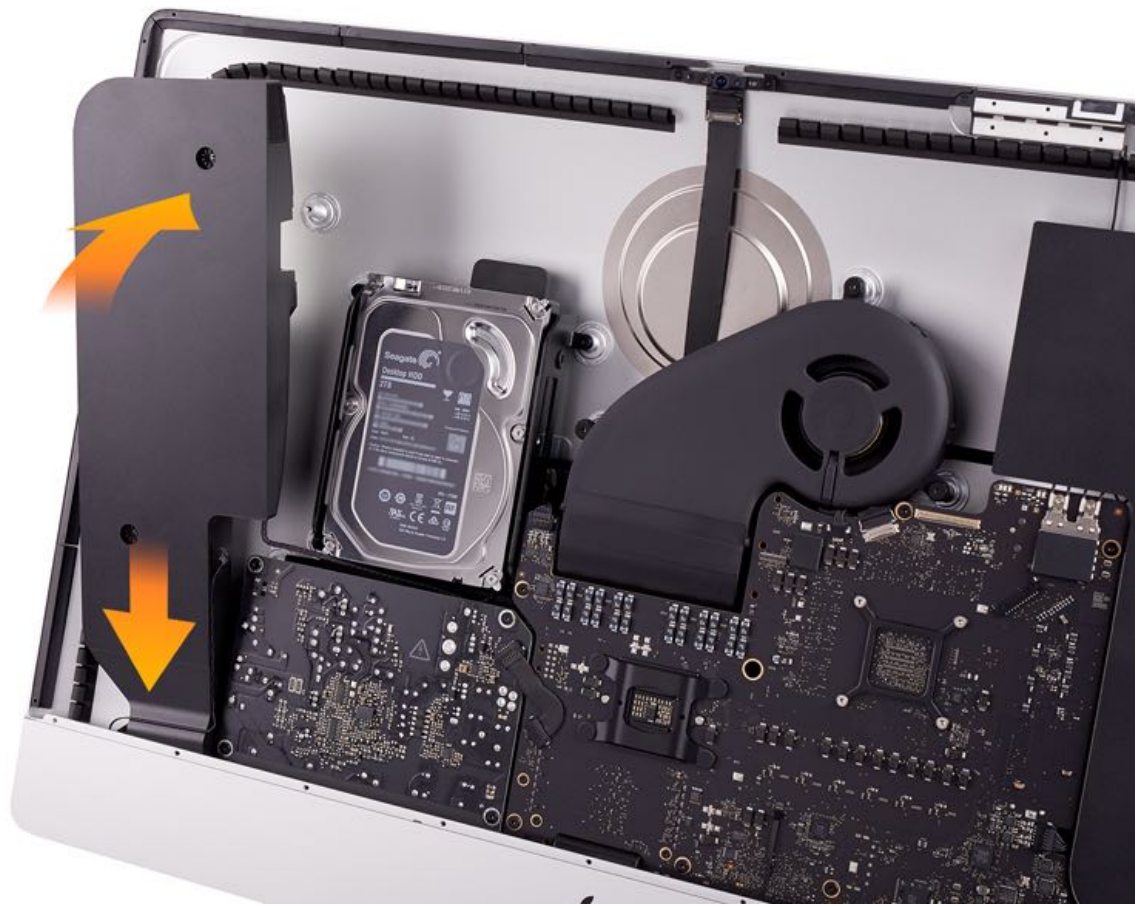
5. Reconnect the hard drive data and power cable to the hard drive. The cable should lay flat under the hard drive. Align the hard drive mounting pins with the rubber grommets on the right mounting bracket.



6. Reinstall the left mounting bracket and two T8 (923-0331) screws.



7. Lower the speaker the rest of the way into the chin, then position it in the rear housing.



8. Place the two T10 (923-0333) speaker screws and partially tighten the screws to keep the speaker in place.
Note: Do not fully tighten the screws at this point.





9. Correct spacing between the left speaker and hard drive requires inserting a 1.85 mm shim between the left speaker and left hard drive mounting bracket. Stack 18 individual sticky notes to make a 1.85 mm shim. Insert the shim between the speaker and left bracket. Tighten the T10 speaker screws after inserting the shim.



10. Connect the power button cable to the power supply.



11. Insert the chin strap into the rear housing. Be sure the metal screw holes face the inside edge of the chin. The air loops on the chin strap should be facing up.

12. Use a black stick to press the chin strap against the front frame, if needed.



13. Reinstall the nine Phillips #00 (923-0338) screws in the chin strap.





14. Reinstall the [display](#).

iMac (Retina 5K, 27-inch, 2019) Right Speaker

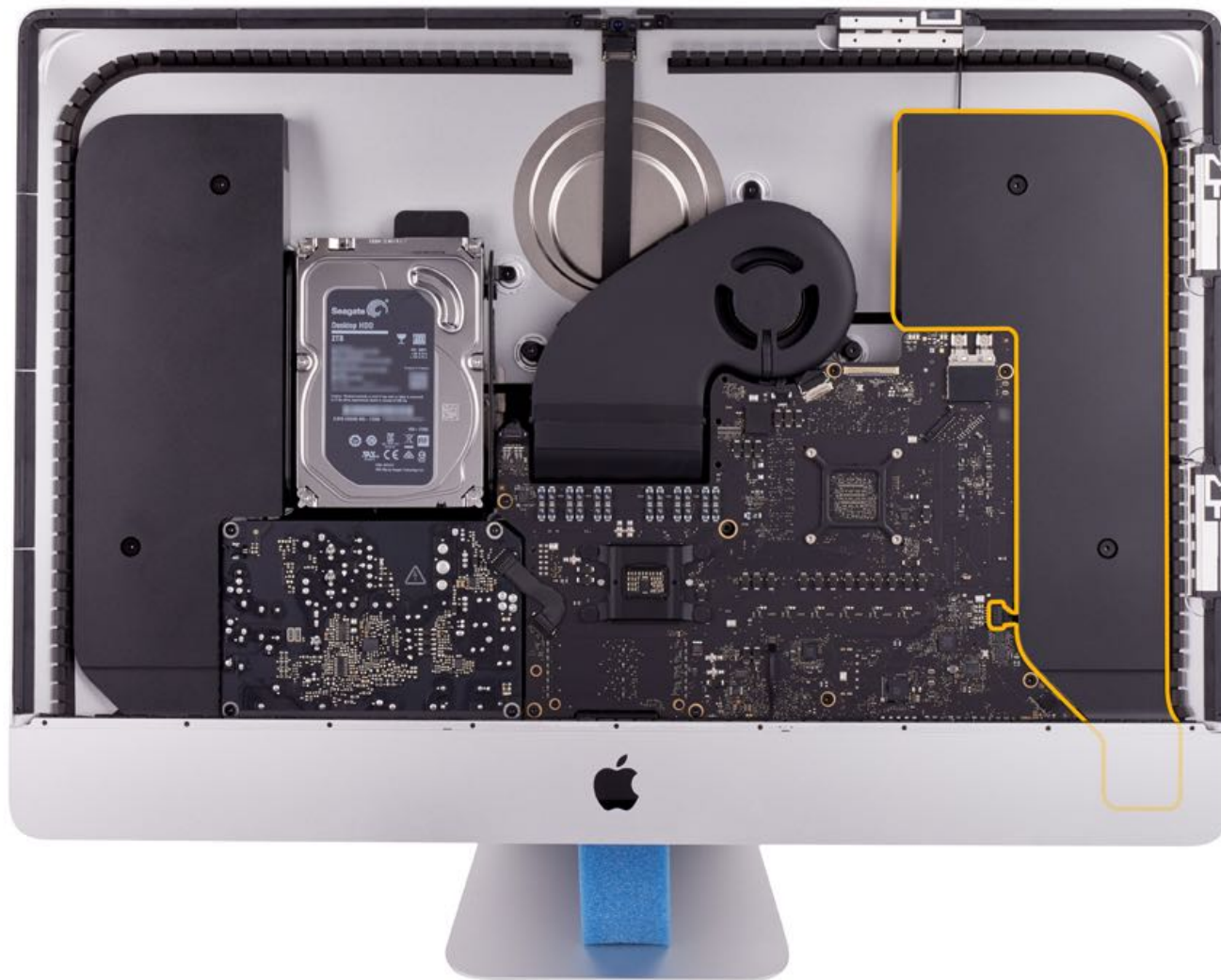
First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

Remove:

- [Display](#)

Important: Speakers must be replaced in pairs. If you replace the right speaker, you must also replace the [left speaker](#).



Tools

1. Black stick
2. iMac service wedge
3. Torx T10 screwdriver
4. Phillips #00 screwdriver



Steps For Removal

1. Remove nine Phillips #00 screws from the chin.



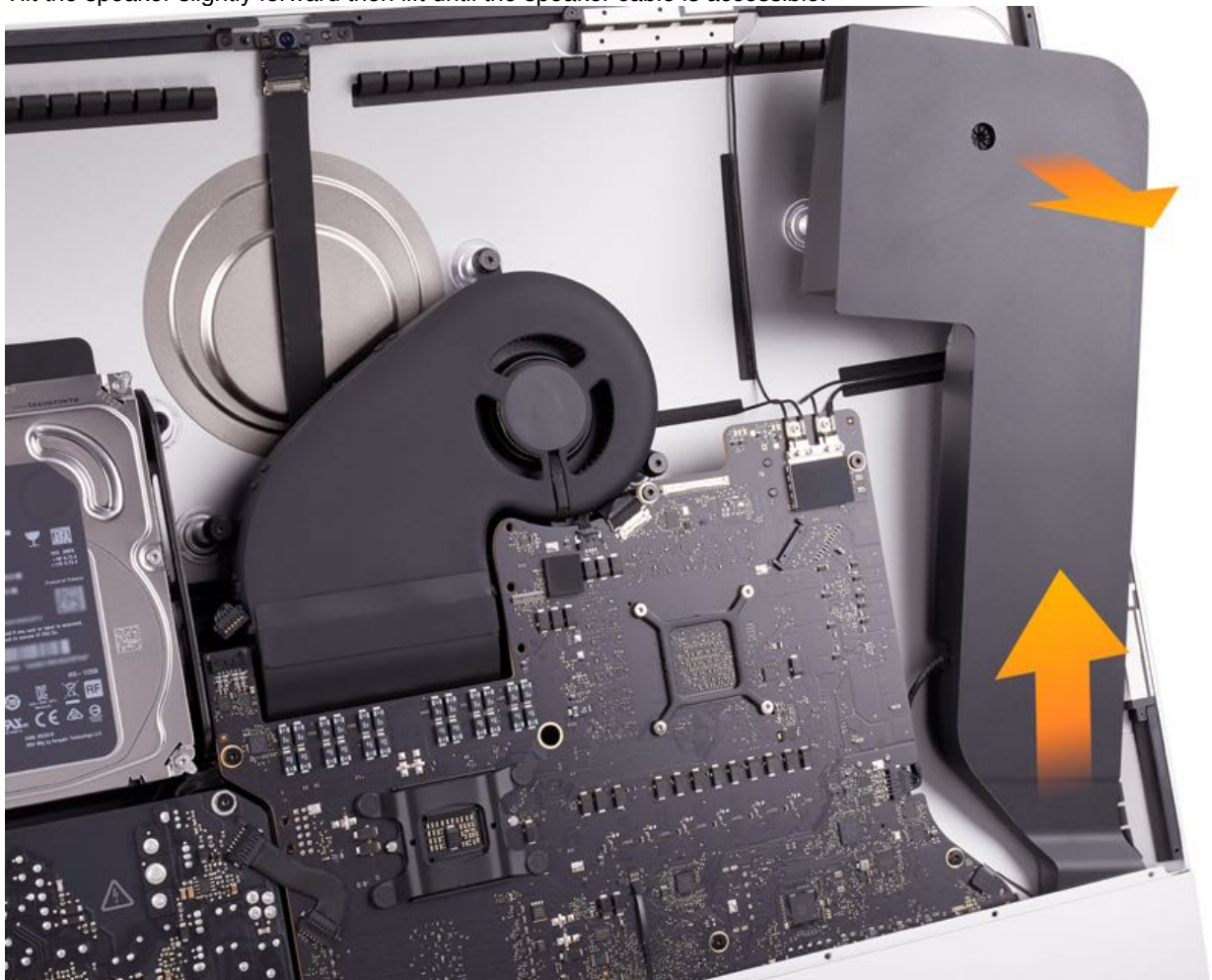
2. Remove the chin strap and set it aside for reuse.
Important: Be careful not to bend the chin strap.



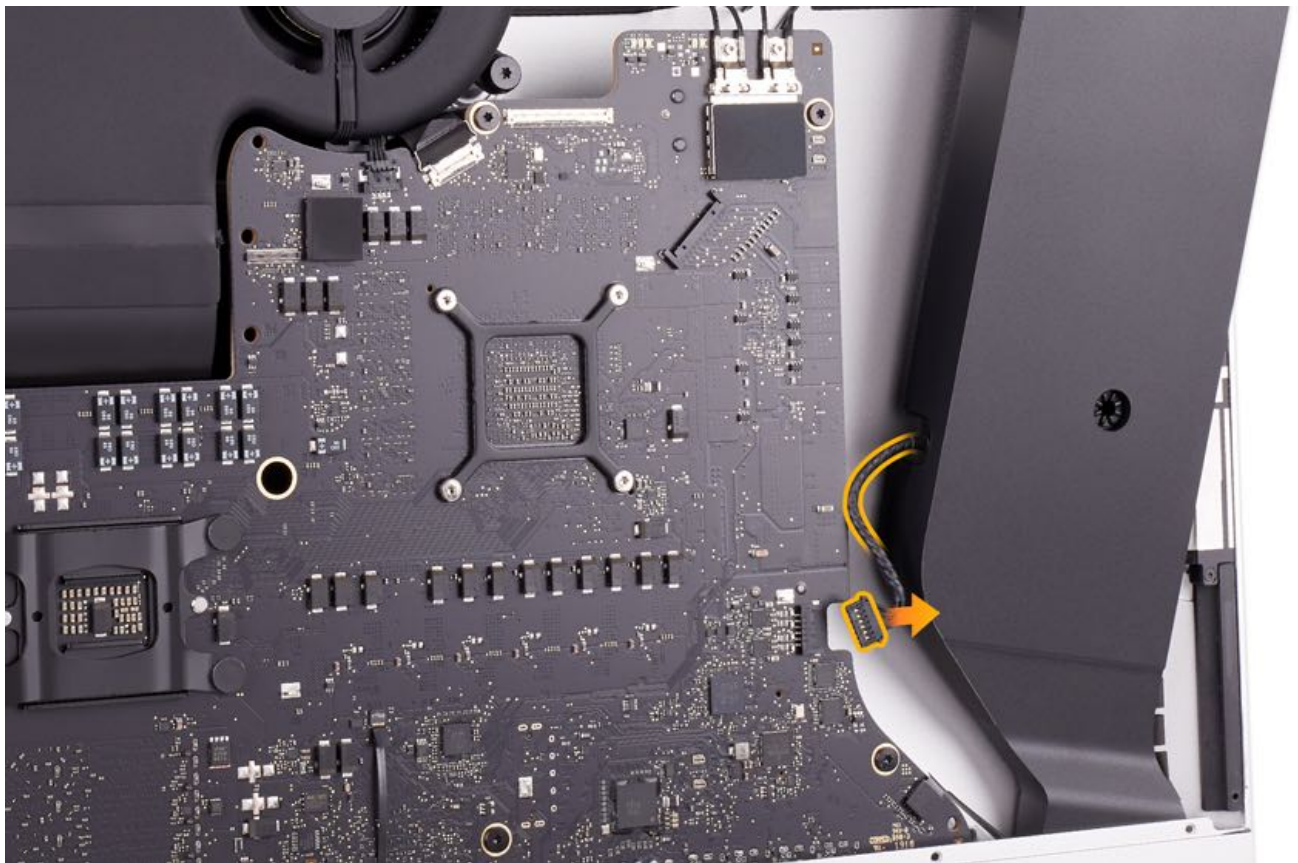
3. Completely unscrew two T10 screws from the speaker.
Note: The screws tighten into rubber grommets and may remain in the screw holes when the speaker is removed.



4. Tilt the speaker slightly forward then lift until the speaker cable is accessible.

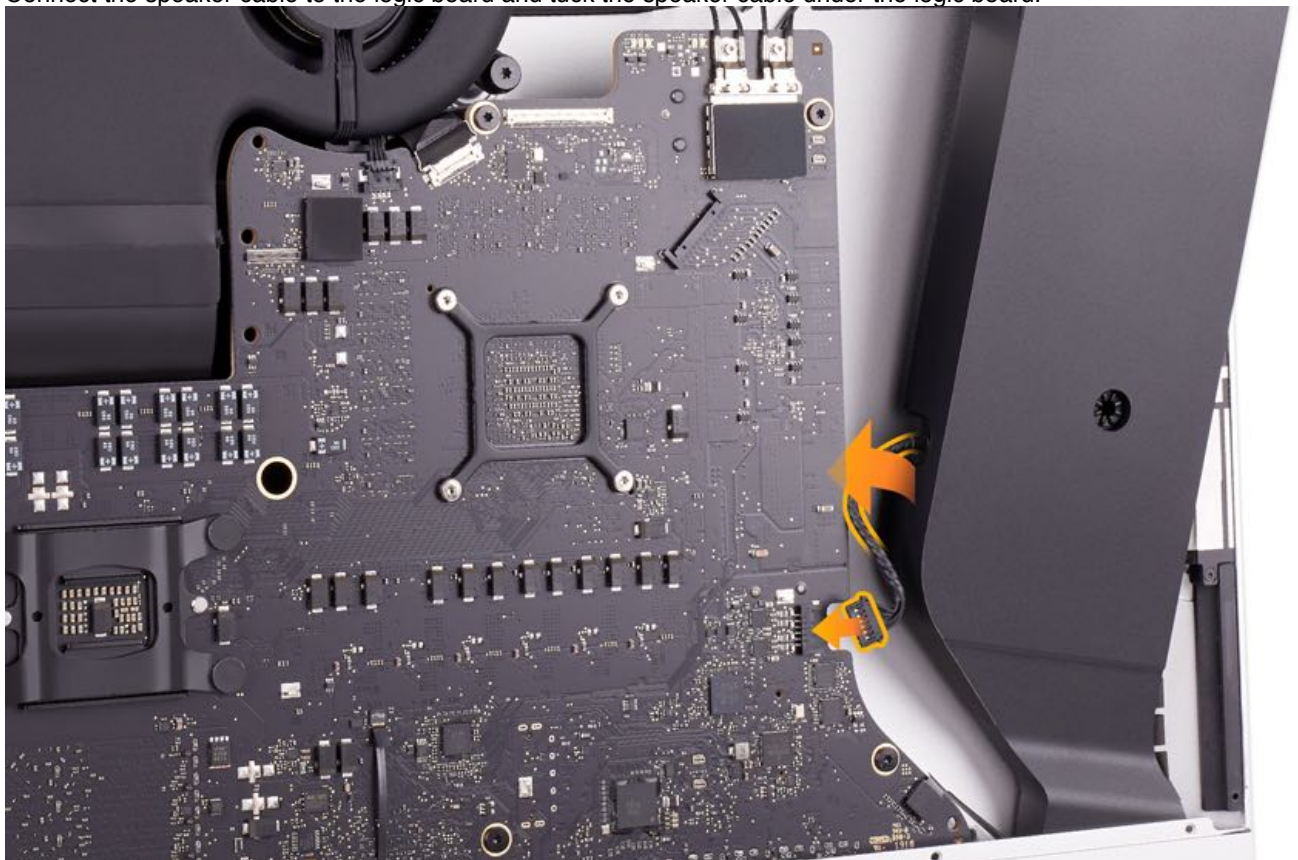


5. Disconnect the speaker cable from the logic board and lift the speaker out of the rear housing.



Steps For Reassembly

1. Partially insert the speaker in the rear housing.
2. Connect the speaker cable to the logic board and tuck the speaker cable under the logic board.



3. Reinstall the two T10 (923-0333) speaker screws.
Caution: Ensure that the speaker sits down inside the rear housing as far as possible. If the speaker is not positioned correctly in the rear housing, it can cause display interference issues.



4. Insert the chin strap into the rear housing. Be sure the metal screw holes face the inside edge of the chin. The air loops on the chin strap should be facing up.



5. Use a black stick to press the chin strap against the front frame, if needed.



6. Reinstall the nine Phillips #00 (923-0338) screws in the chin strap.





7. Reinstall the [display](#).

iMac (Retina 5K, 27-inch, 2019) Hard Drive

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).



Caution: Ensure customer data is backed up before removing the hard drive.

For video instruction, refer to [SV244: Hard Drive Replacement Video](#).

Remove:

- [Display](#)
- [Left speaker](#)



Tools

1. Sticky notes
2. iMac service wedge
3. Torx T8 and T10 screwdrivers
4. Phillips #00 screwdriver



Steps For Removal

1. While supporting the hard drive with one hand, remove two T8 screws from the left mounting bracket. Remove the left mounting bracket.



2. Slide the hard drive out of the rubber grommets on the right mounting bracket. Disconnect the hard drive data and power cable and remove the hard drive.



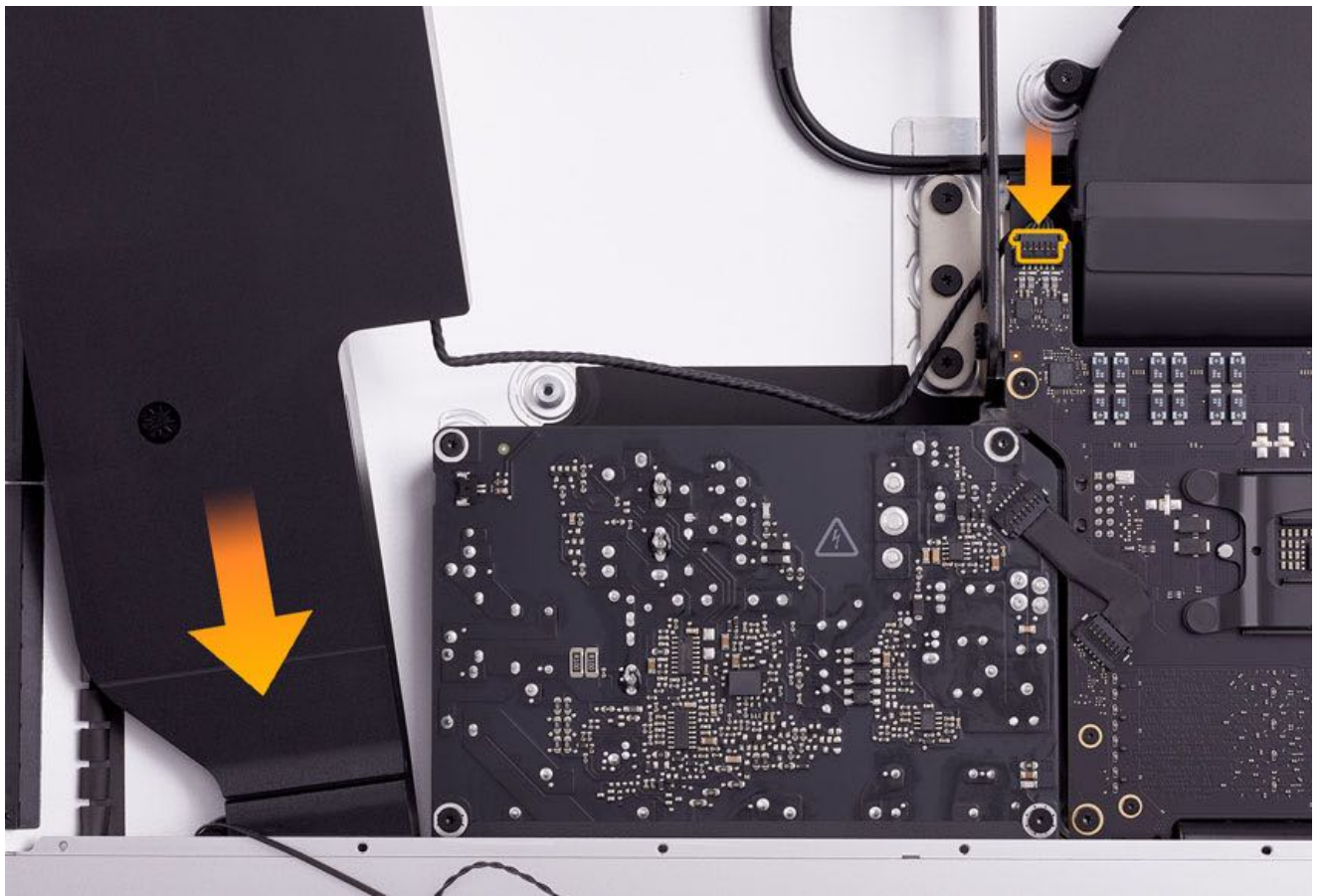
3. **Important:** If installing a replacement hard drive, transfer the four T8 hard drive mounting pins.

- 923-01675



Steps For Reassembly

1. Position the left speaker in the rear housing. Route the speaker cable along the top edge of the power supply and under the right hard drive mounting bracket. Connect the speaker cable to the logic board.



2. Route the power button cable in the groove on the bottom and side of the speaker.
Caution: Ensure that the power button cable does not bind or slip out of the routing groove as you place the speaker into the rear housing.



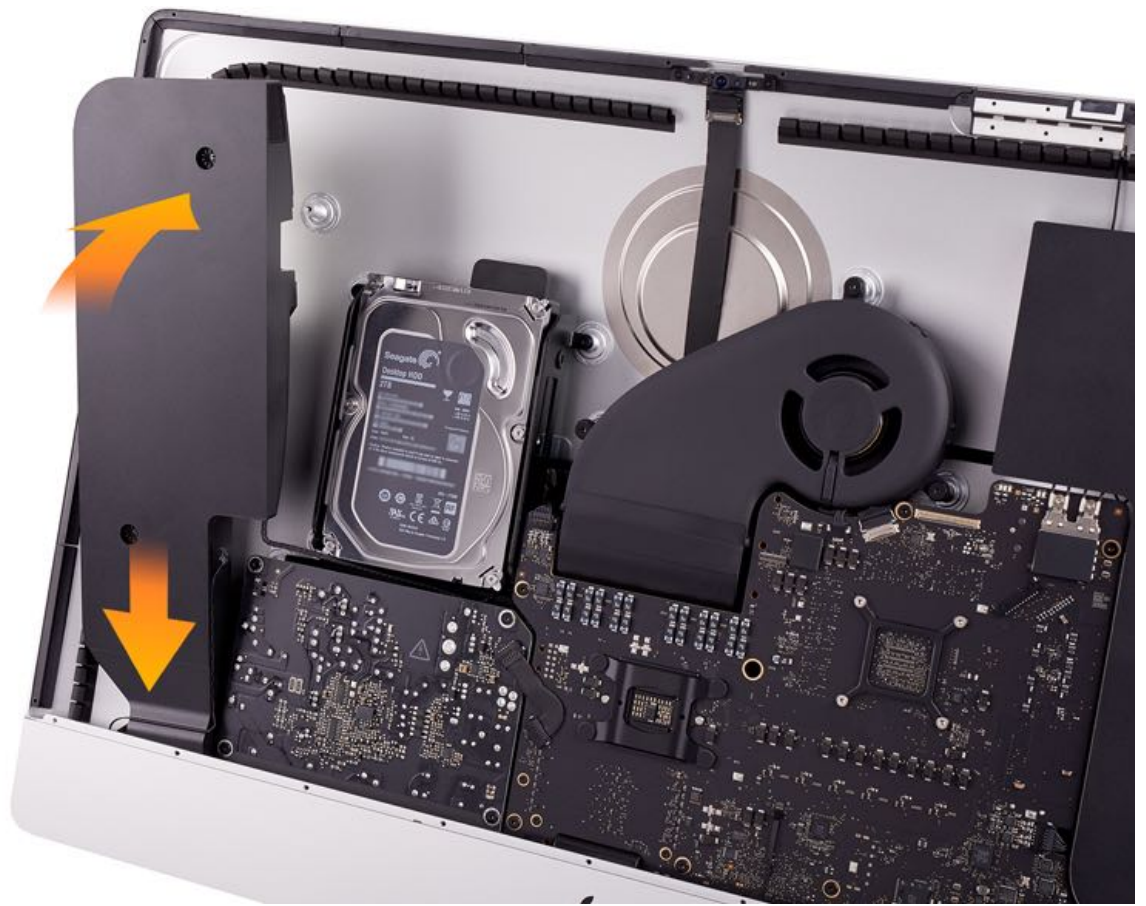
3. Reconnect the hard drive cable. The cable should lay flat under the hard drive. Align the hard drive mounting pins with the rubber grommets on the right mounting bracket.



4. Reinstall the left mounting bracket and two T8 (923-0331) screws.



5. Lower the speaker the rest of the way into the chin, then position it in the rear housing.



6. Place the two T10 (923-0333) speaker screws and partially tighten the screws to keep the speaker in place.
Note: Do not fully tighten the screws at this point.





7. Correct spacing between the left speaker and hard drive requires inserting a 1.85 mm shim between the left speaker and left hard drive mounting bracket. Stack 18 individual sticky notes to make a 1.85 mm shim. Insert the shim between the speaker and left bracket. Tighten the speaker screws after inserting the shim.



8. Connect the power button cable to the power supply.



9. Insert the chin strap into the rear housing. Be sure the metal screw holes face the inside edge of the chin. The air loops on the chin strap should be facing up.

10. Use a black stick to press the chin strap against the front frame, if needed.



11. Reinstall the nine Phillips #00 (923-0338) screws in the chin strap.





12. Reinstall the [display](#) to complete reassembly.

iMac (Retina 5K, 27-inch, 2019) Power Supply

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

For video instruction, refer to [SV246: Power Supply Replacement Video](#).

Remove:

- [Display](#)
- [Left speaker](#)
- [Hard drive](#)



Tools

1. Black stick
2. iMac service wedge
3. Torx T8 screwdriver



Steps For Removal



Warning: HIGH VOLTAGE. Use extreme caution when troubleshooting with the display panel removed. Avoid touching the logic board or power supply while the computer is plugged in, the power supply retains a charge whether or not the computer is on.

After unplugging the computer from the electrical outlet, wait two minutes before removing display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.

- Never remove or install any physical components while the computer is plugged in to an electrical outlet.
- When plugged in, the power supply and logic board are energized, even when the computer is turned off.
- Unplug the computer and allow sufficient time for the power supply and logic board to self-discharge before removing the display panel.
- Do NOT touch the logic board or power supply while the computer is plugged in, or before sufficient time has passed to discharge stored voltage to a safe level after being unplugged.

Warning: iMac (Late 2012 and later) models require two protective covers (923-0189) when performing live adjustments; one for the power supply and one for the backlight control circuitry on the logic board. Secure the covers to the rear housing with tape, as shown in the following articles:

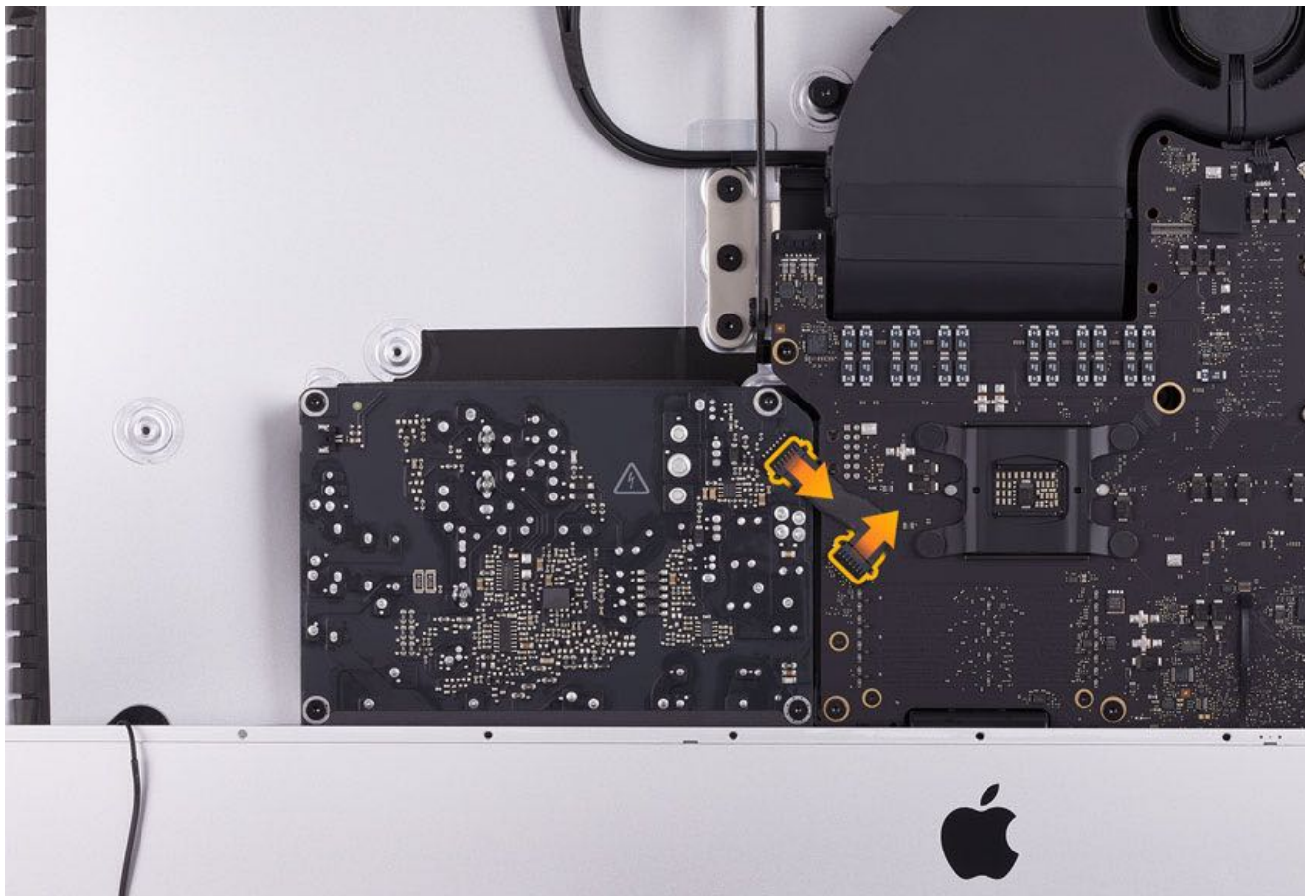
- [TP833: iMac and Displays: Power Supply Cover Instructions](#)
- [TP820: iMac \(27-inch\): Safety](#)

Electrical Safety Precautions

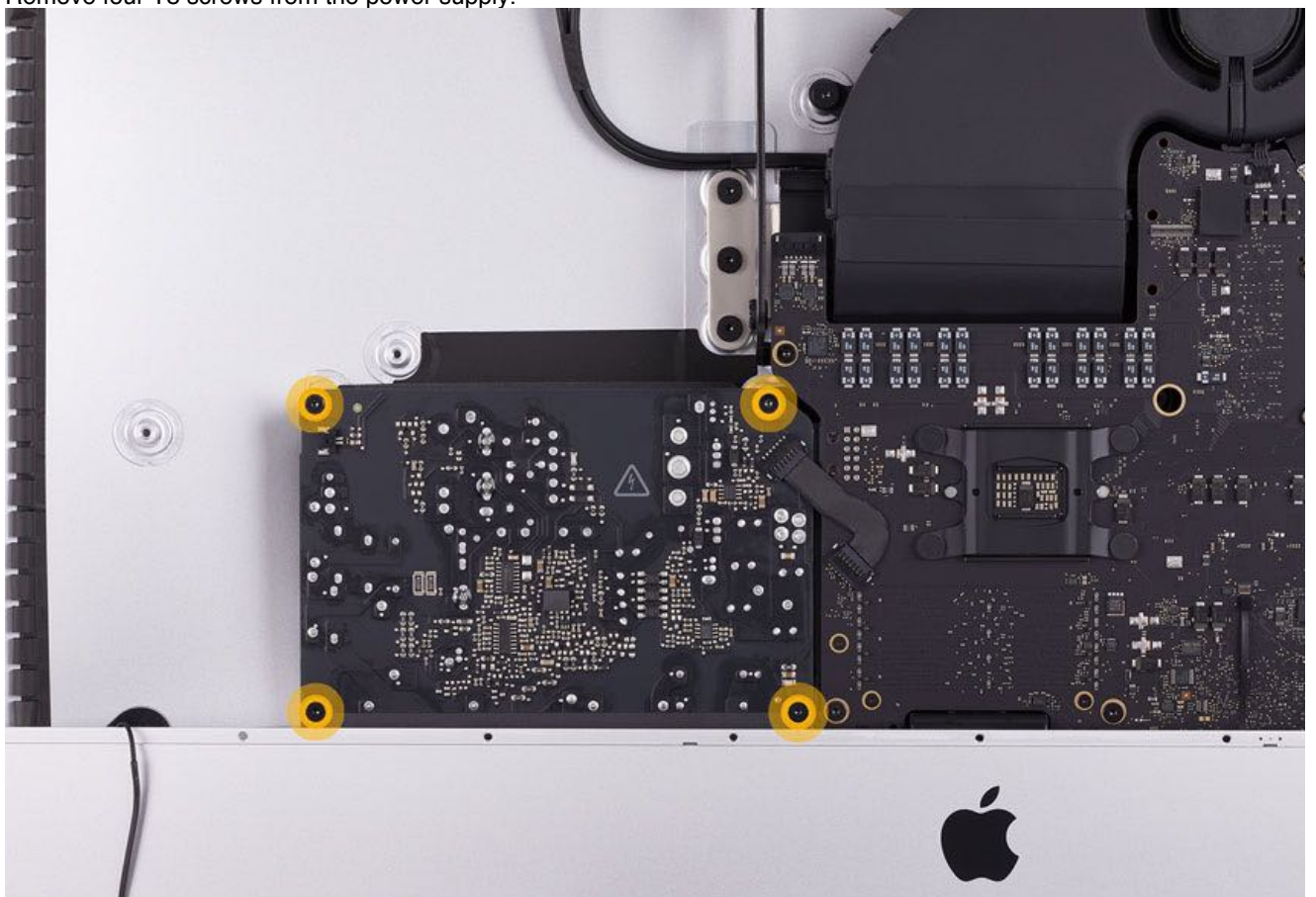
Before working on a computer with exposed, potentially energized parts:

- Remove rings, watches, necklaces, metal-rimmed eyewear, and other metallic articles which increase your risk of electric shock.
- Do not wear a cell phone or other signaling device, as these may cause a dangerous startle reflex during energized work.
- If the iMac needs to be plugged in for LED checks or similar troubleshooting, do not wear an ESD wrist strap. Wearing ESD grounding systems increases your risk of electric shock.
- Remain alert, focused on the work being performed, and aware of the proximity of grounded objects to your body.
- Use the plastic black stick or other nonmetal extension tool as needed to connect or disconnect cables, to keep fingers away from potentially energized parts.

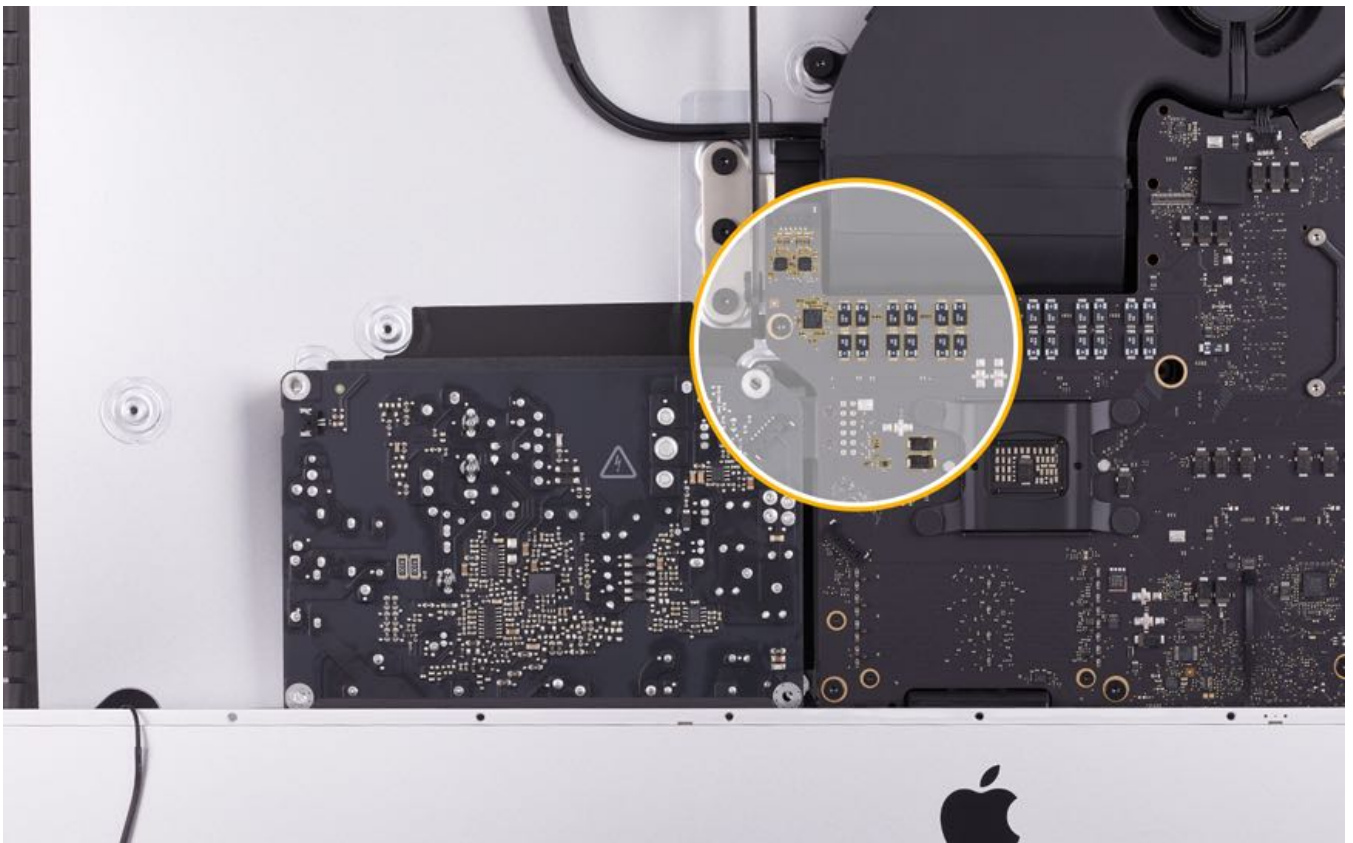
1. Disconnect the power signal cable from the power supply and logic board.



2. Remove four T8 screws from the power supply.



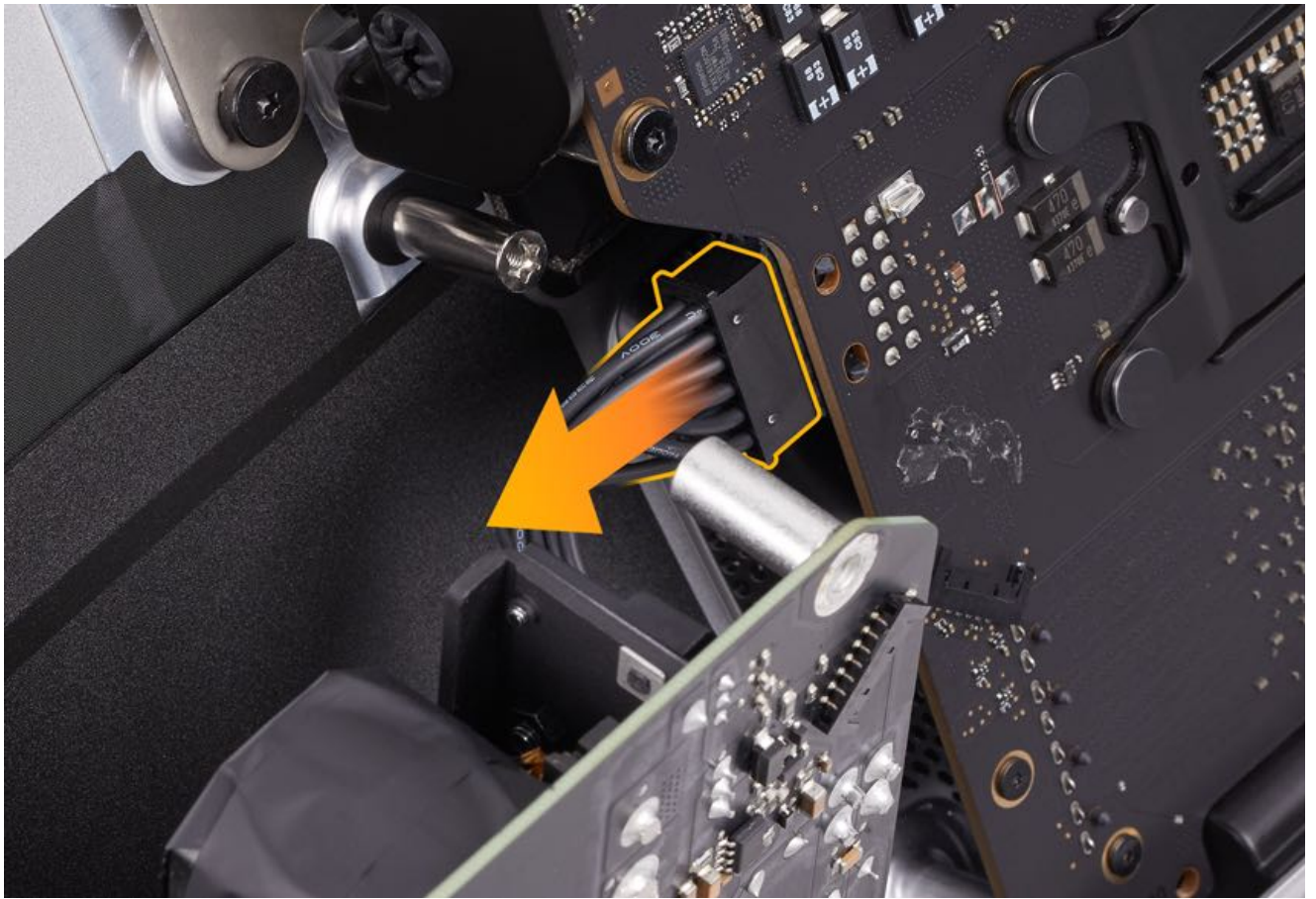
Caution: When performing step 3, do not rotate the power supply toward the logic board as it could damage parts of the logic board.



3. Slide the power supply slightly to the left (1), then tilt the power supply slightly forward (2).



4. Pinch the clip on the rear side of the DC cable connector and pull to disconnect the cable.
Note: This is a tight connection. Pinch and pull hard on the connector, not the cable.



Important: To better understand what you are disconnecting in the previous step, the image below shows the clip on the rear side of the DC cable.



5. Tilt the power supply forward to disconnect the AC cable. Pinch the clip on the AC cable and pull to disconnect. Lift the power supply out of the rear housing.

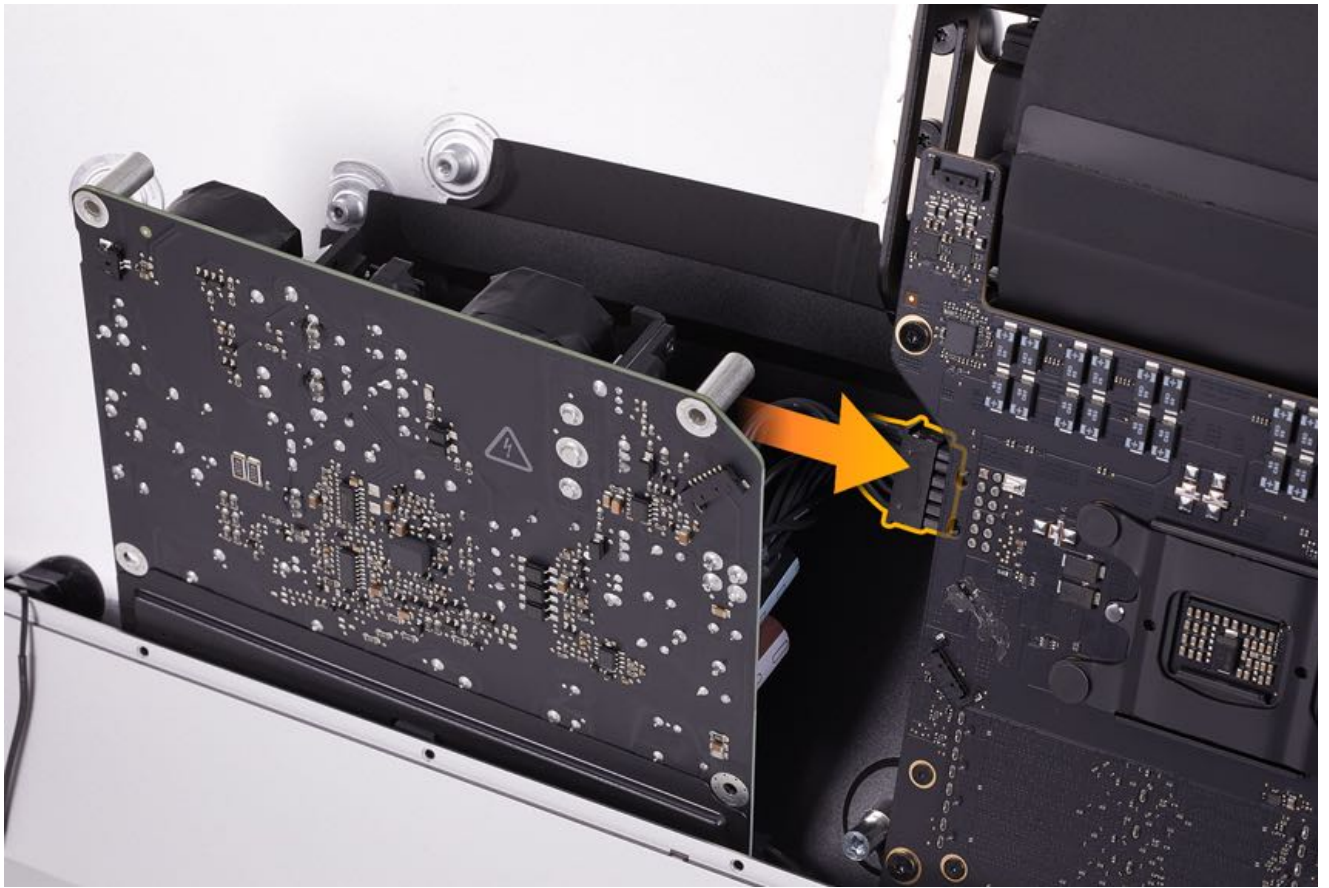


Steps For Reassembly

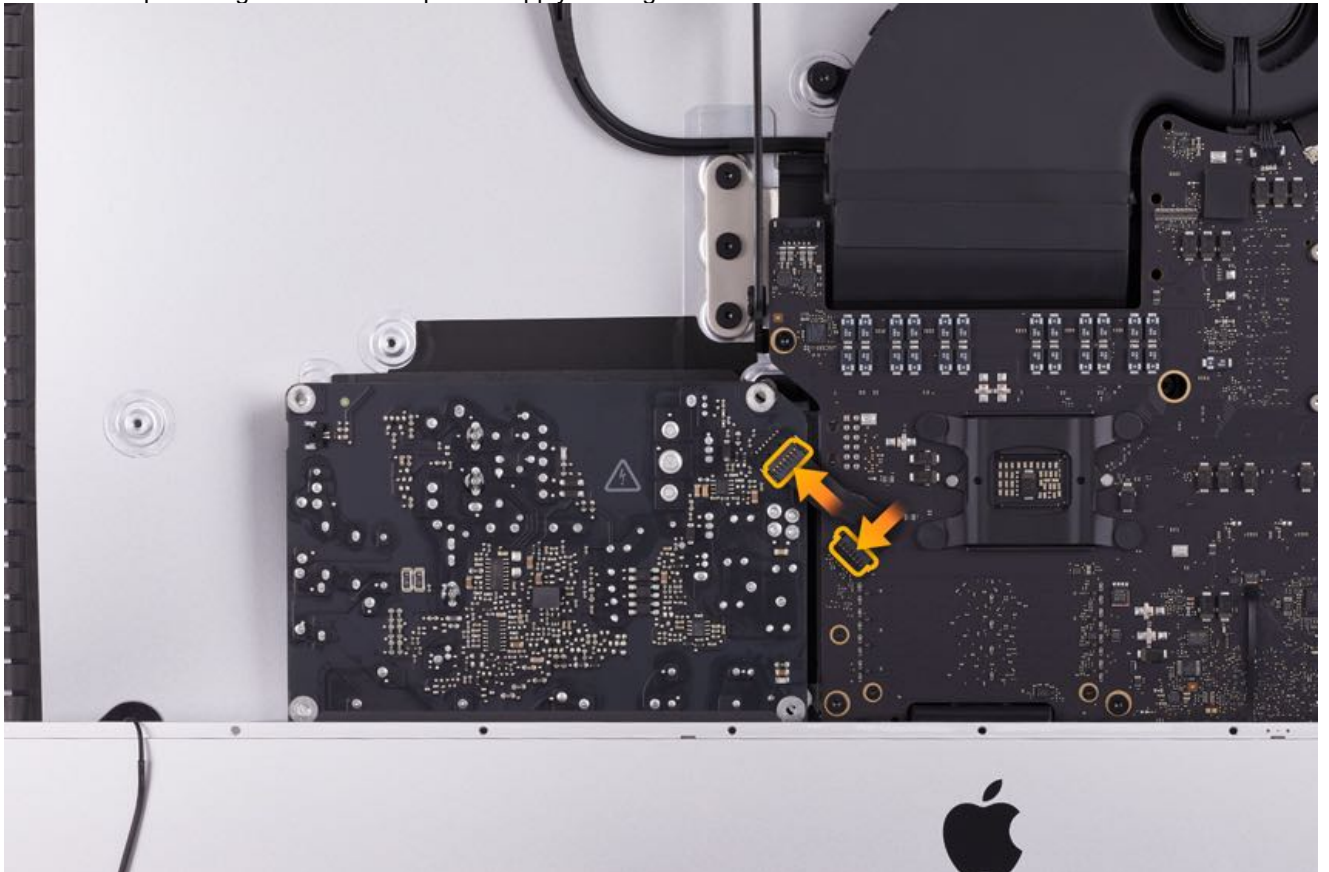
1. Connect the AC cable to the power supply. Check that the cable is securely connected.



2. Lower the power supply into the rear housing and connect the DC cable to the logic board. Check that the cable is securely connected.



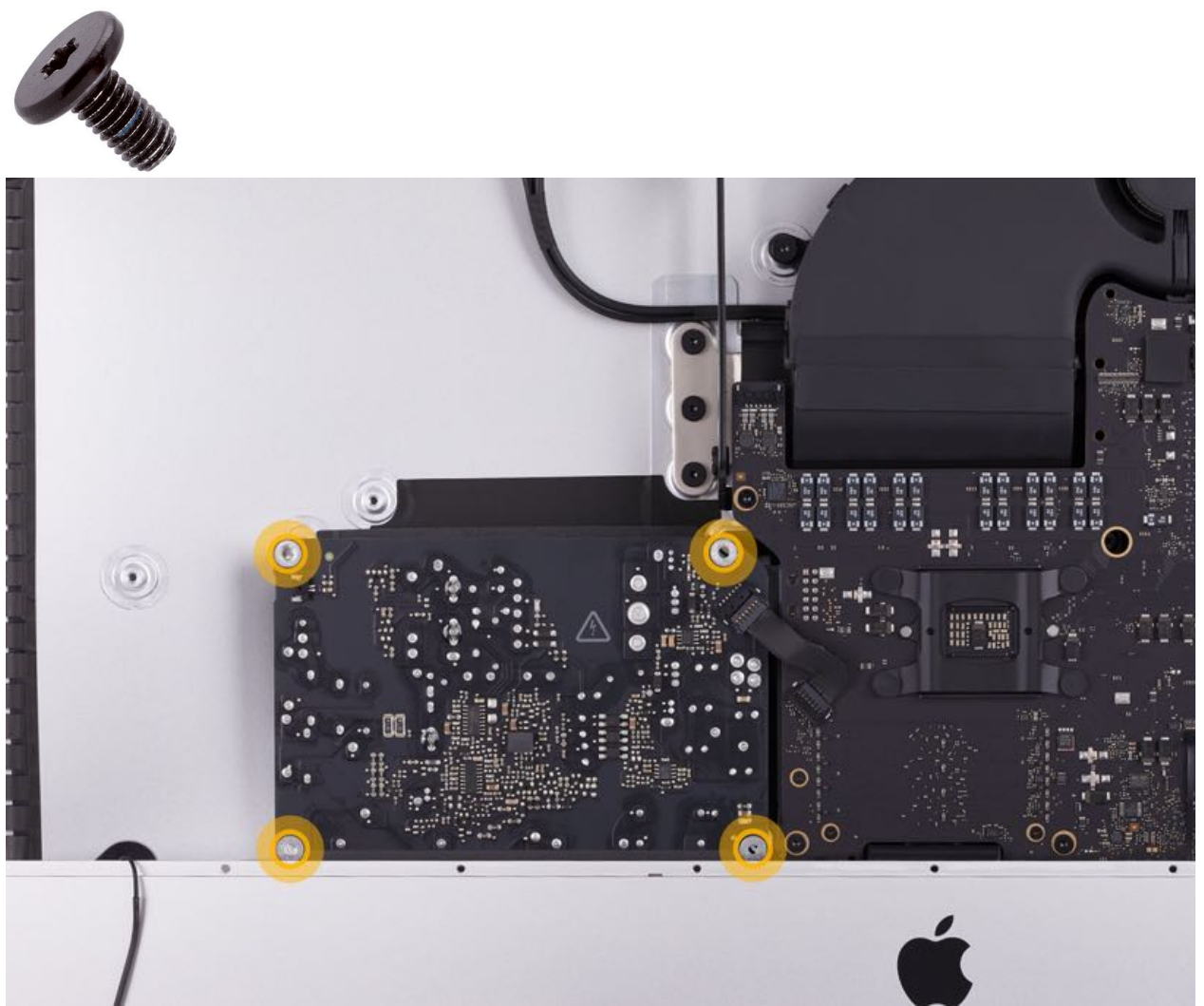
3. Connect the power signal cable to the power supply and logic board.



4. Reinstall the four T8 power supply screws.
Note: Reinstall the two long screws (1) at the top first, then the two shorter screws (2) at the bottom.



2. 923-0331: two short screws on the bottom.



5. Reinstall the [hard drive](#).
6. Reinstall the [left speaker](#).
7. Reinstall the [display](#).

iMac (Retina 5K, 27-inch, 2019) Logic Board

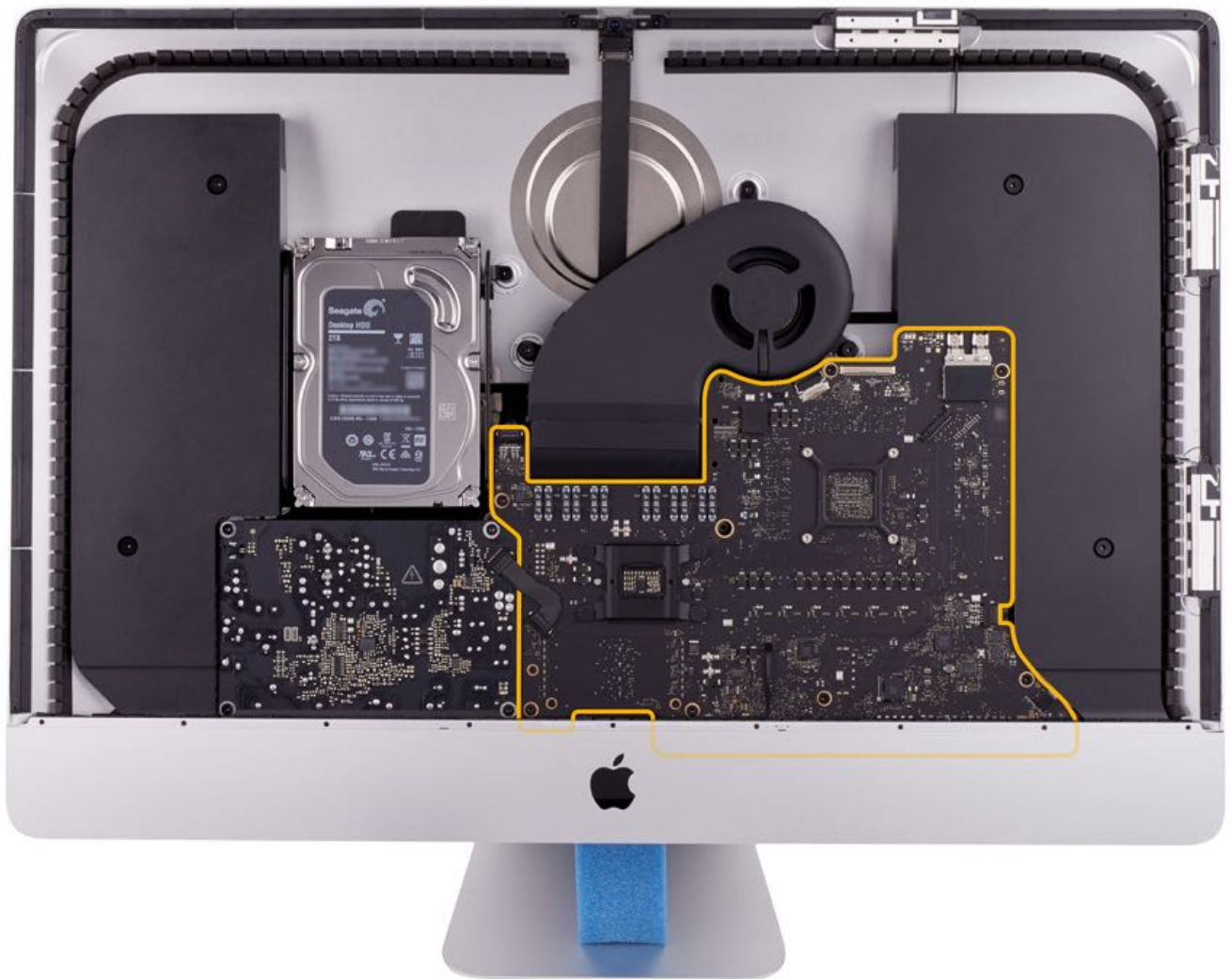
First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

For video instruction, refer to [SV245: Logic Board Replacement Video](#).

Remove:

- [Display](#)
- [Fan](#)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#)
- [Power supply](#)



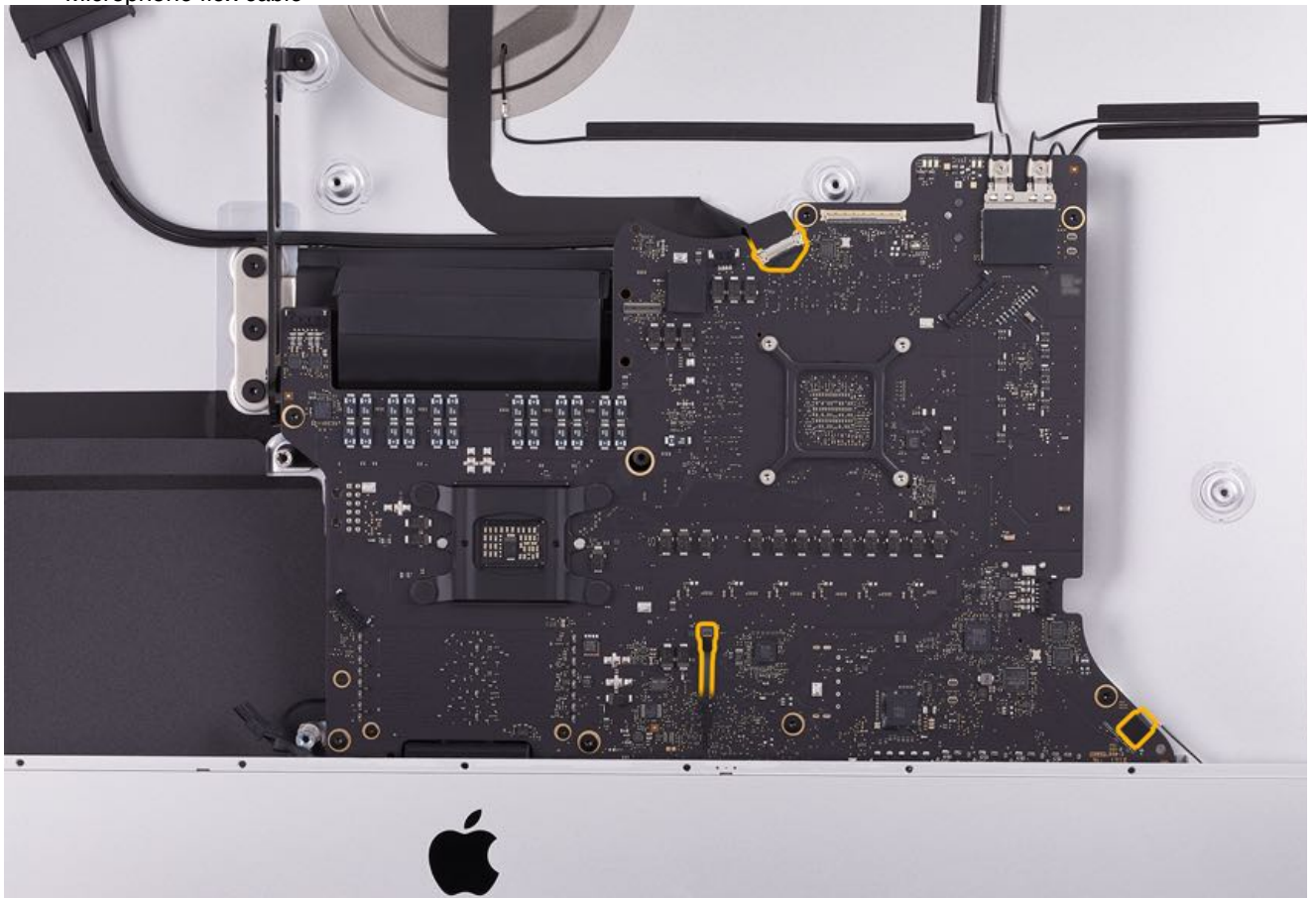
Tools

1. Black stick
2. Antenna tool (923-01322)
3. Torx T5 screwdriver
4. Torx T8 screwdriver
5. Torx T10 screwdriver
6. Torx T25 screwdriver
7. Wireless card support tool (923-03085)
8. Apple USB-C or Thunderbolt cable, USB cable (not shown), or SD Card (not shown)
9. iMac service wedge
10. Painters tape (1 to 2 inches wide)



Steps For Removal

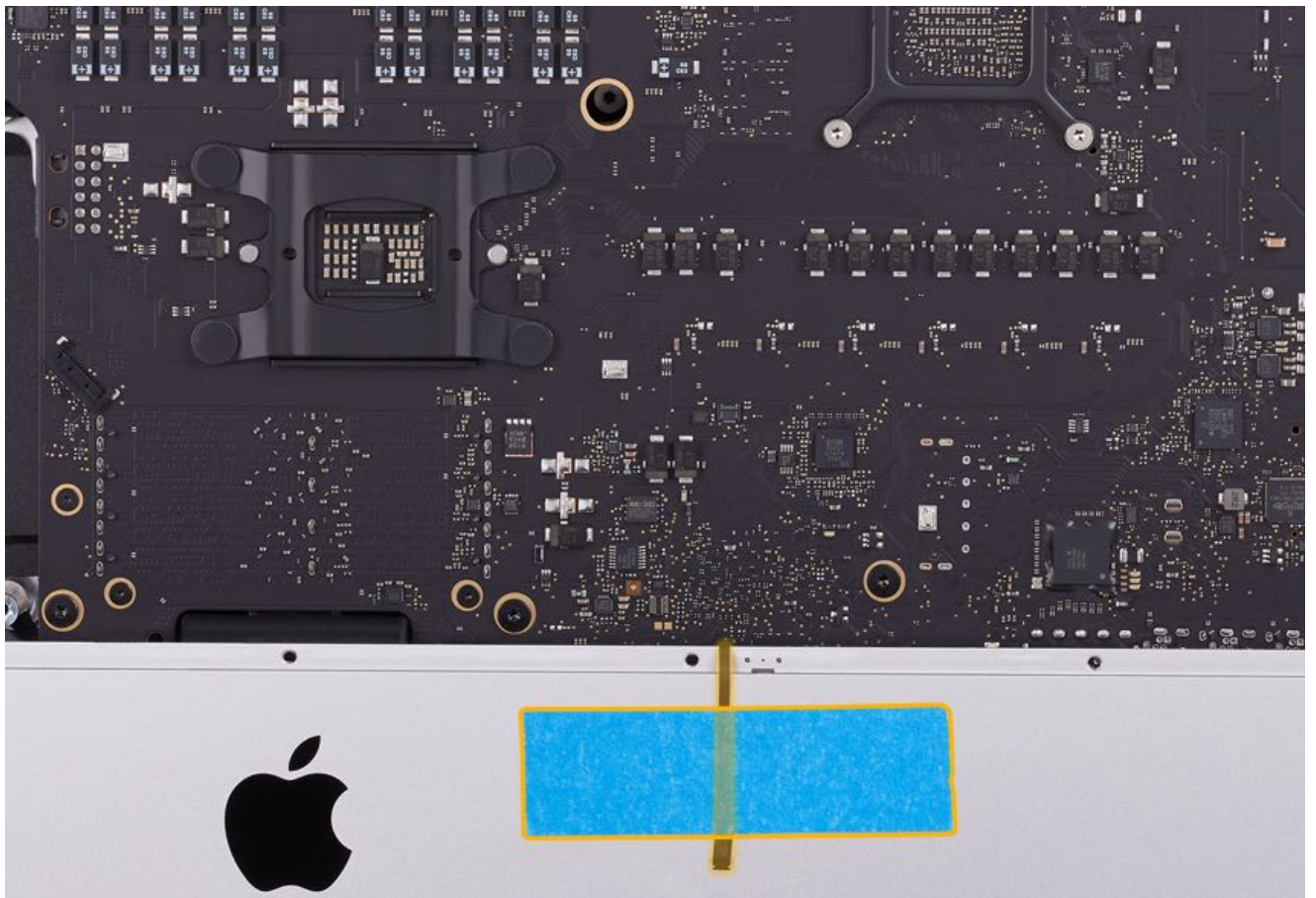
1. Disconnect the following cables from the logic board:
 - Camera cable
 - Audio cable
 - Microphone flex cable



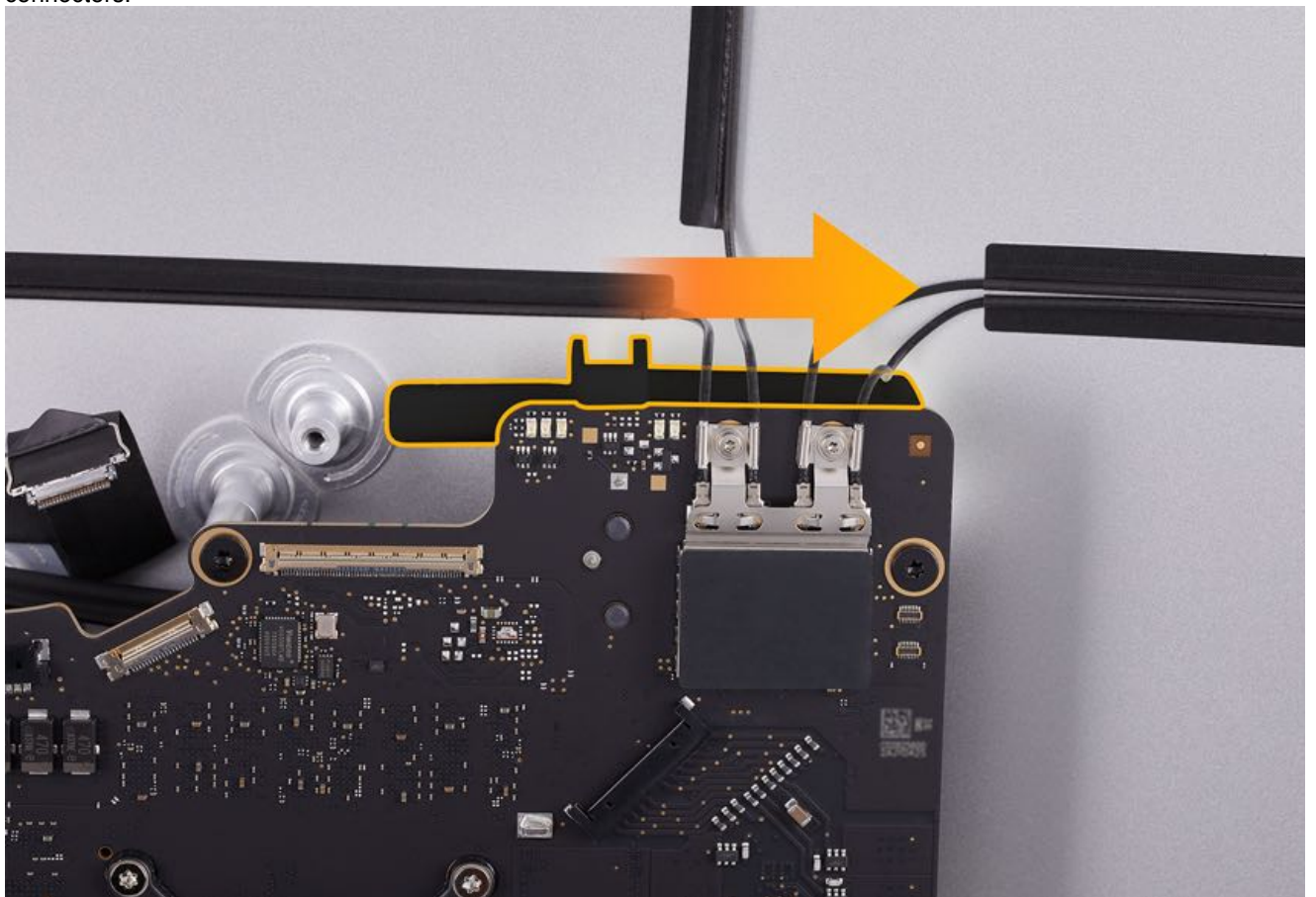
2. Tape the microphone flex cable to the front of the chin.



Caution: Be careful not to crimp the flex cable. A broken microphone flex cable requires a rear housing replacement.



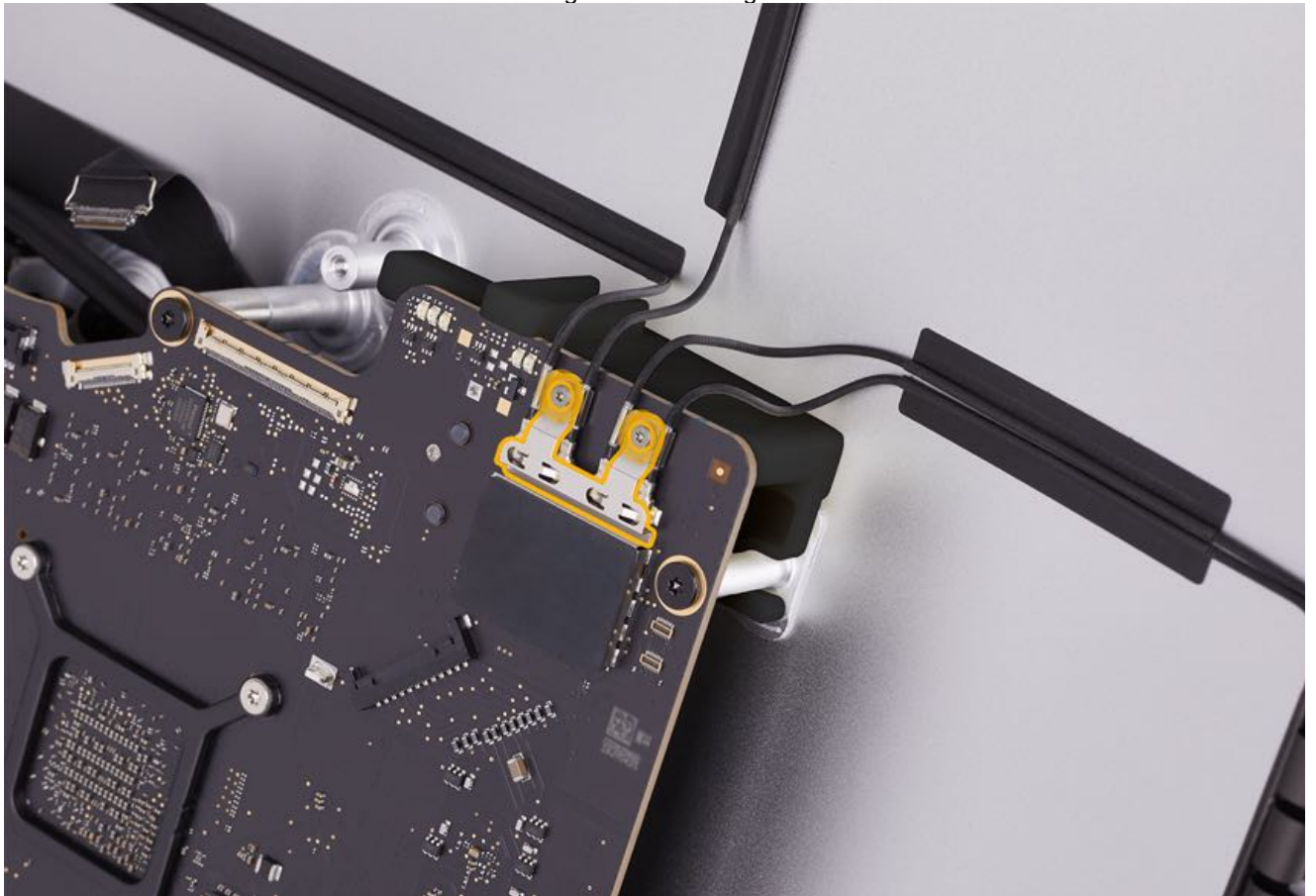
3. Grasp the wireless card support tool handle, lower the tool onto the logic board, and slide it behind the antenna connectors.



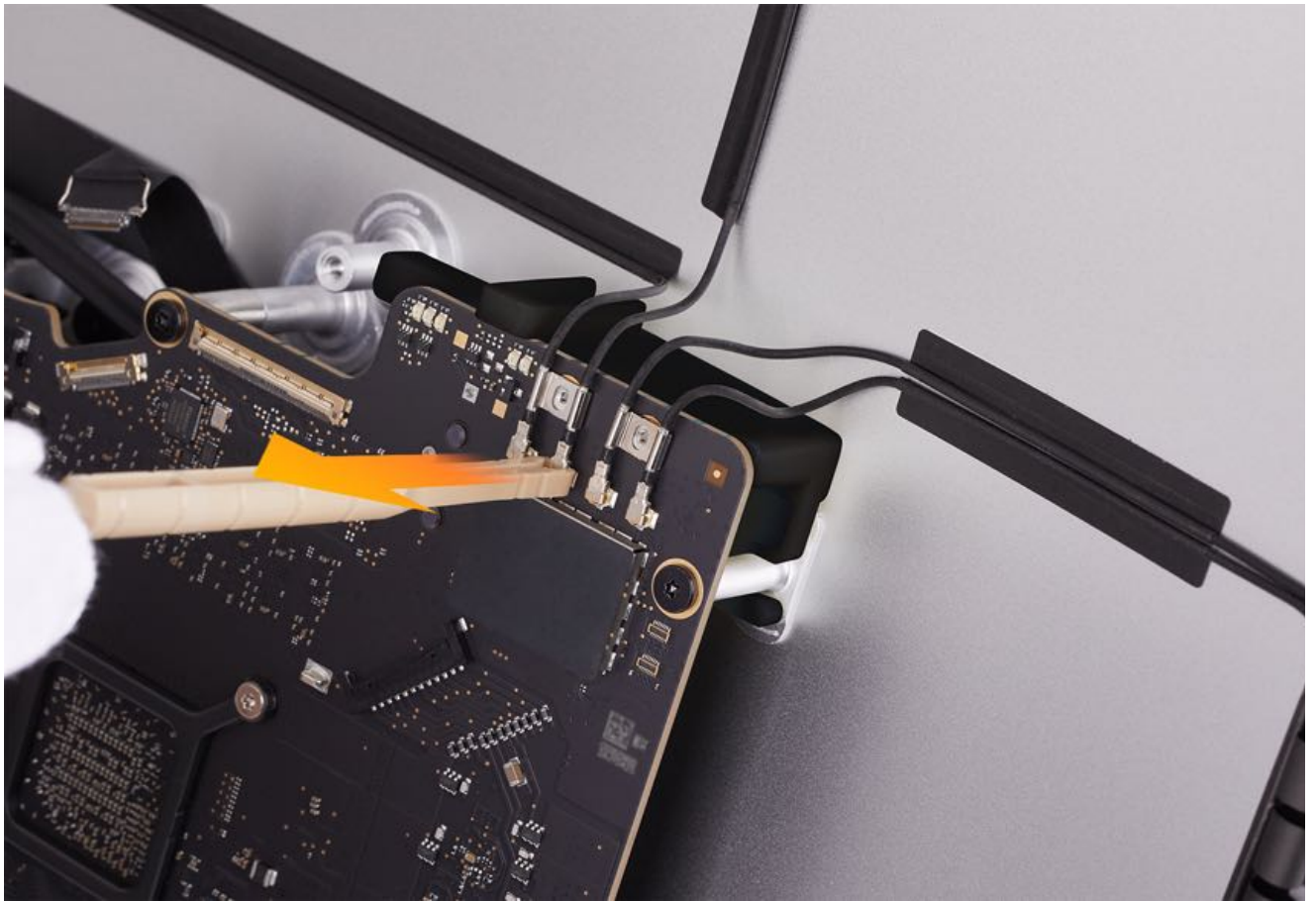
Caution: Avoid the coin cell battery when inserting the tool.



4. Remove the two T5 screws from the antenna cowling. Set the cowling aside for reuse.



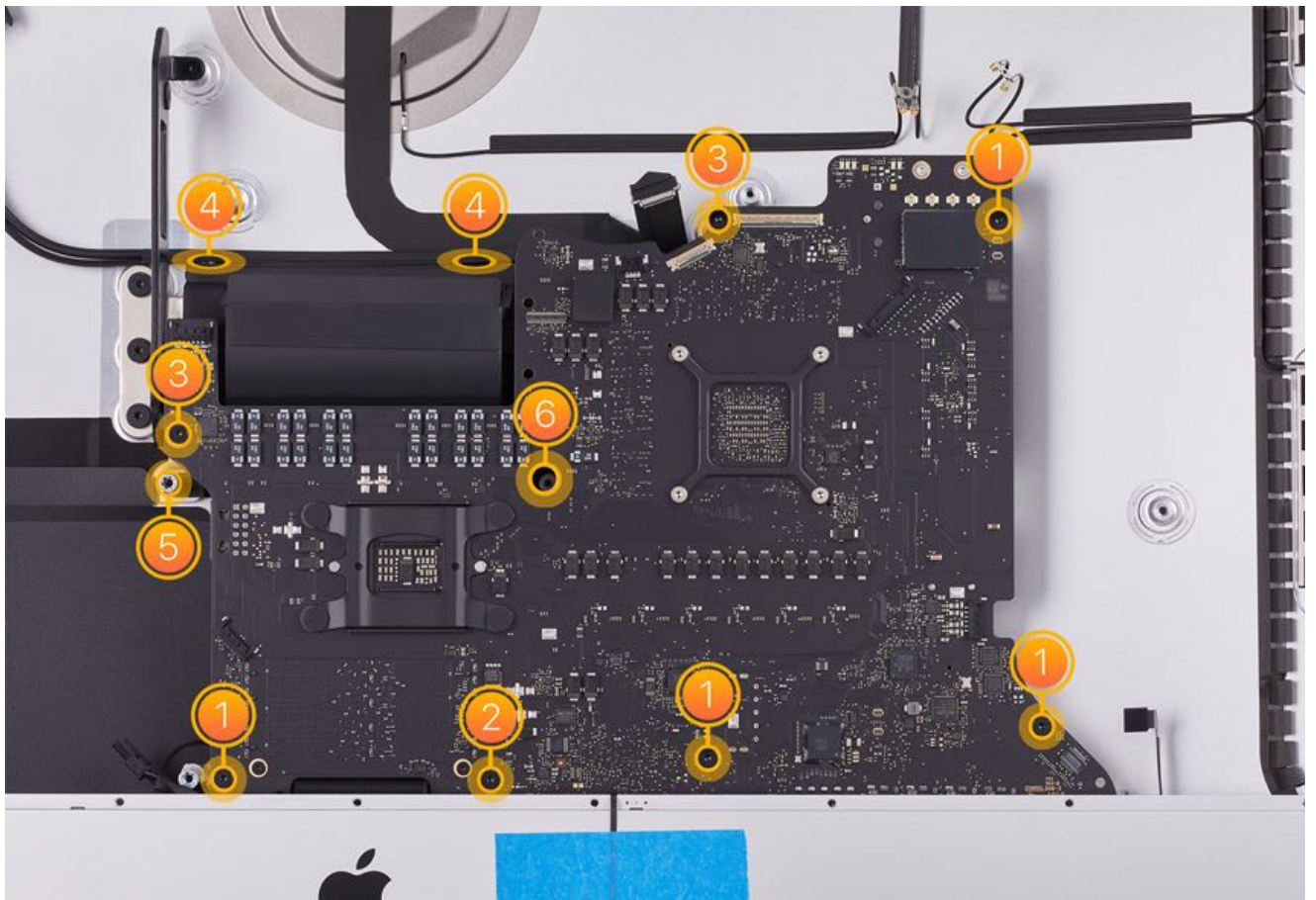
5. Use the antenna tool to disconnect the antennas from the logic board.



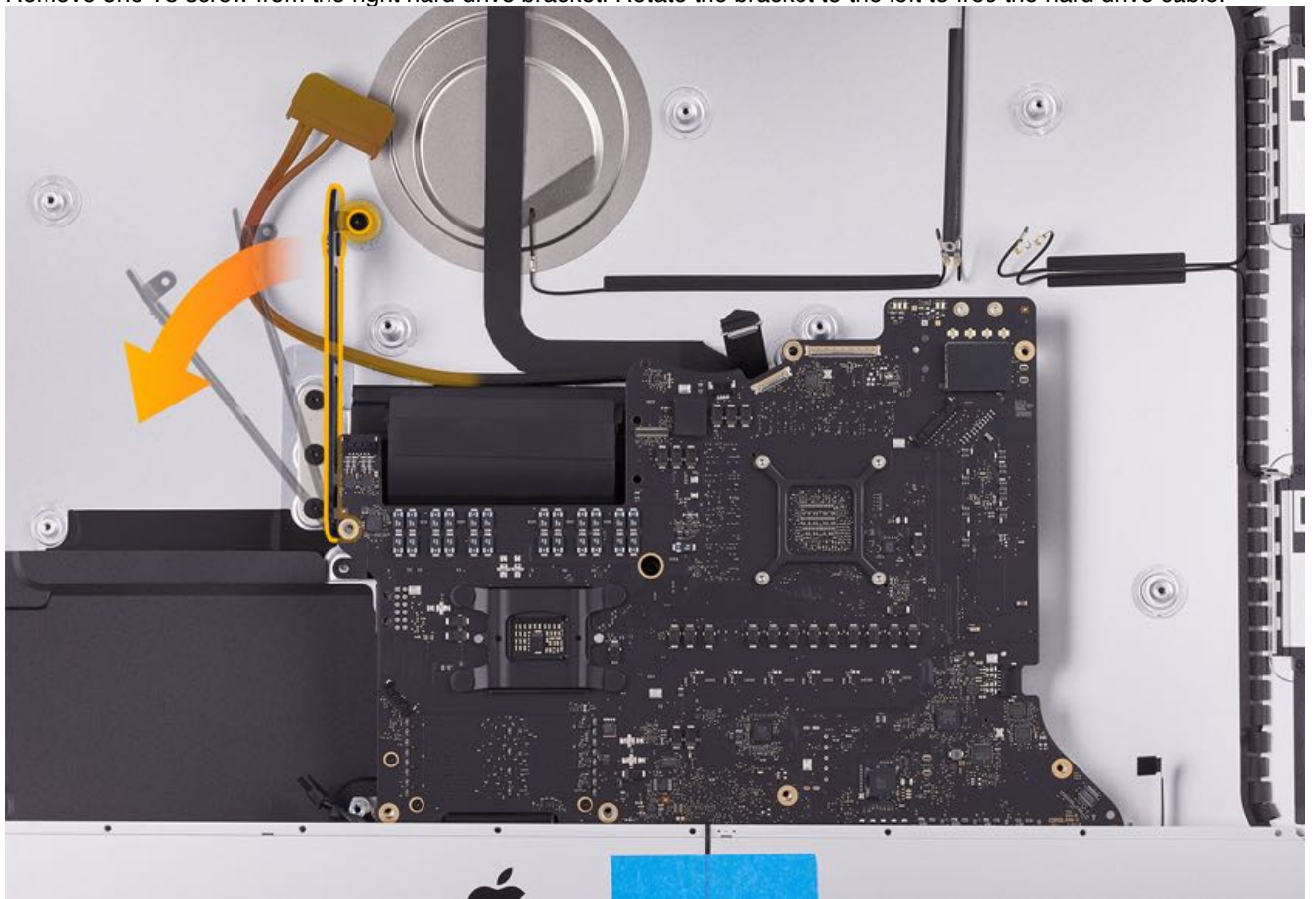
6. Remove the wireless card support tool.



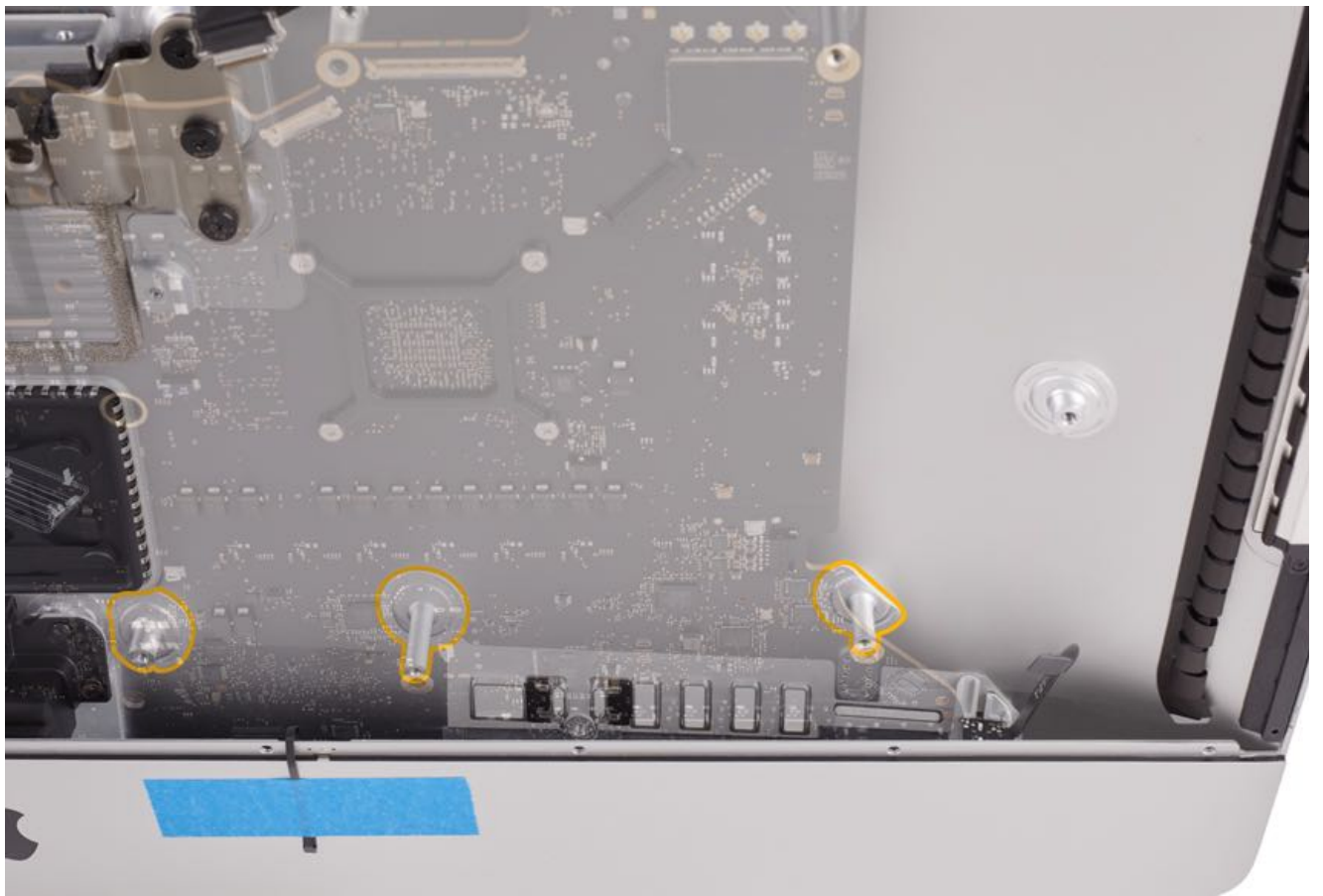
7. Remove seven T8 screws (1–3) from the logic board, two T10 screws (4) from the heat sink, and one T25 standoff (5). Completely unscrew, but do not remove, the T8 captive screw (6) from the center of the board. Refer to the image below for details.



8. Remove one T8 screw from the right hard drive bracket. Rotate the bracket to the left to free the hard drive cable.



Caution: Be extremely careful when removing and reinstalling the logic board. Refer to the following two images before proceeding to removal step 9.





9. Slowly tilt the logic board forward, avoiding contact with the front chin. When the I/O ports on the back of logic board are clear of the rear housing standoffs, lift the logic board up and out of the rear housing.



Caution: Handling the logic board incorrectly can damage chips and circuits. Be extremely careful when removing and reinstalling the logic board. Components that contact the enclosure, standoffs, or other modules may cause damage and prevent the iMac from operating correctly.



Steps For Reassembly

1. If you are installing a replacement logic board, transfer these parts from the old logic board:
 - [Hard drive data and power cable](#)
 - [Memory](#)
 - [Power supply](#) signal cable
 - [Flash storage](#) (if present)
2. Slowly insert the logic board into the rear housing, avoiding contact with the front chin.



When the I/O ports on the back of the logic board rest below the rear housing standoffs, insert the logic board the rest

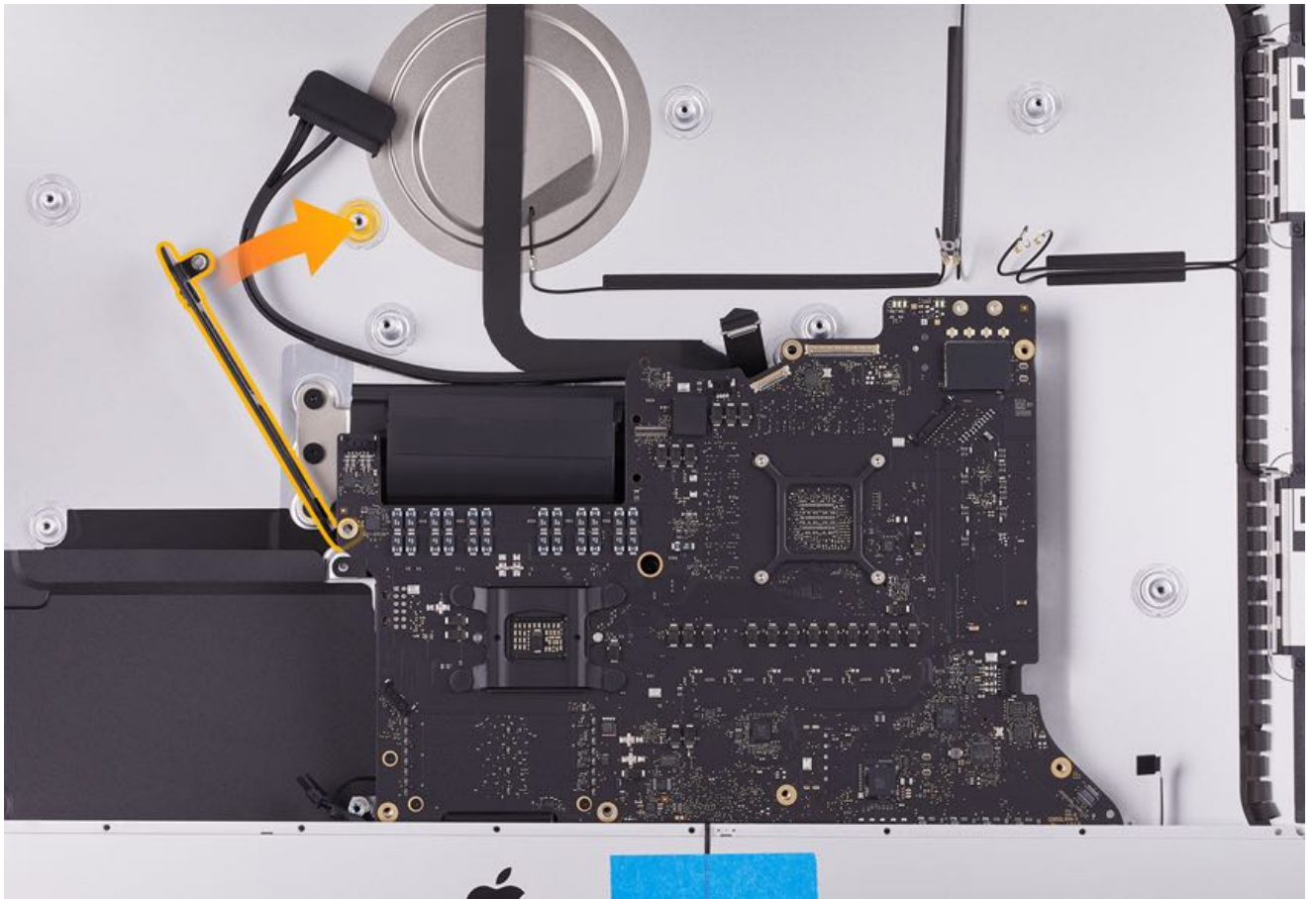
3.

of the way into the rear housing. Align the I/O ports with the openings of the rear housing.



4. Place the hard drive data and power cable behind the right hard drive bracket. Rotate the bracket into place and reinstall the one T8 screw.





5. Partially reinstall the screws to keep the logic board in place.
Note: Do not fully tighten the screws at this point.

Screw legend:

- 1 = Four short T8 screws: 923-0331



- 2 = One medium T8 screw: 923-00767



- 3 = Two long T8 screw: 923-0396



- 4 = Two T10 shoulder screws: 923-0395

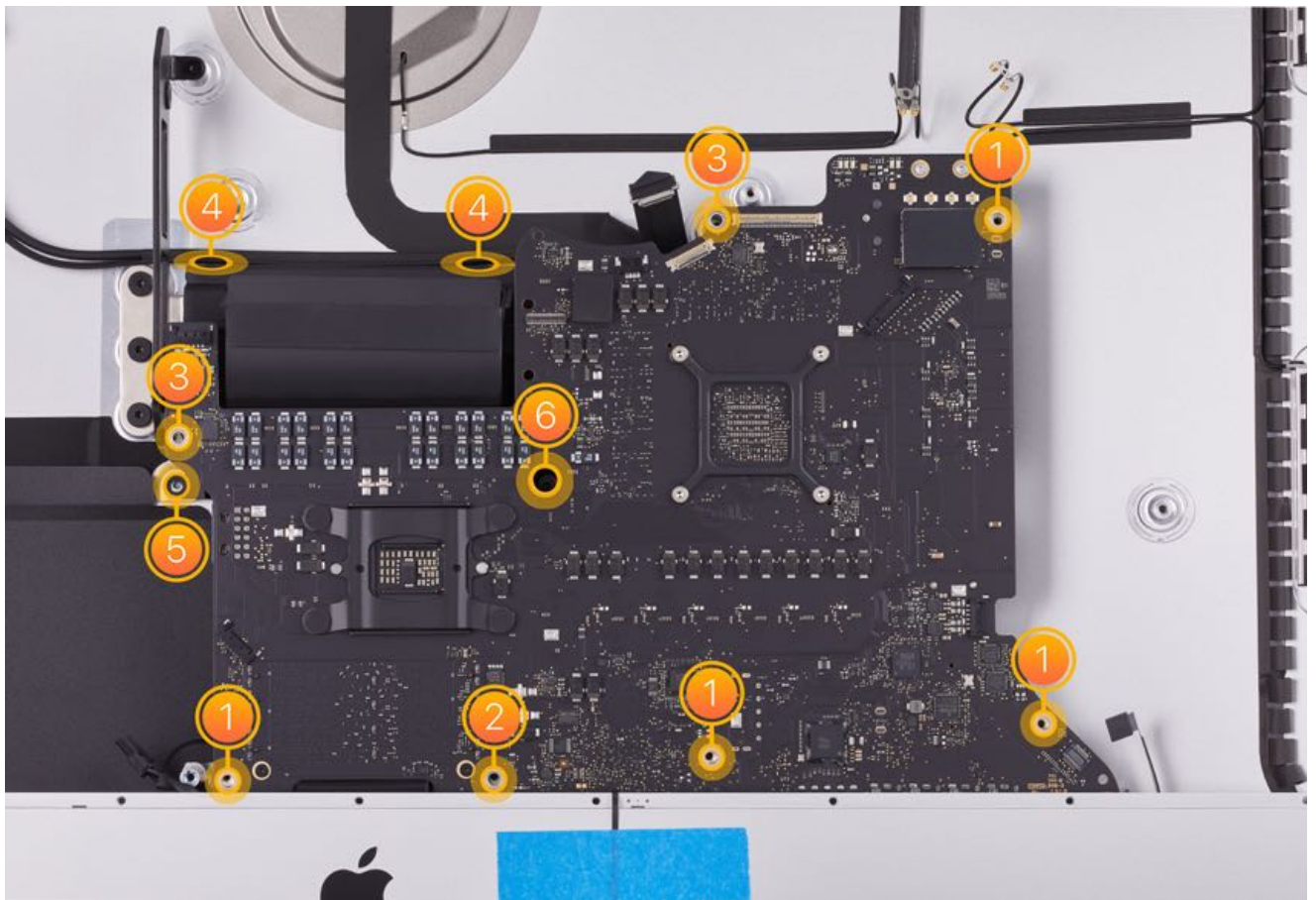


- 5 = One T25 standoff screw: 923-0520

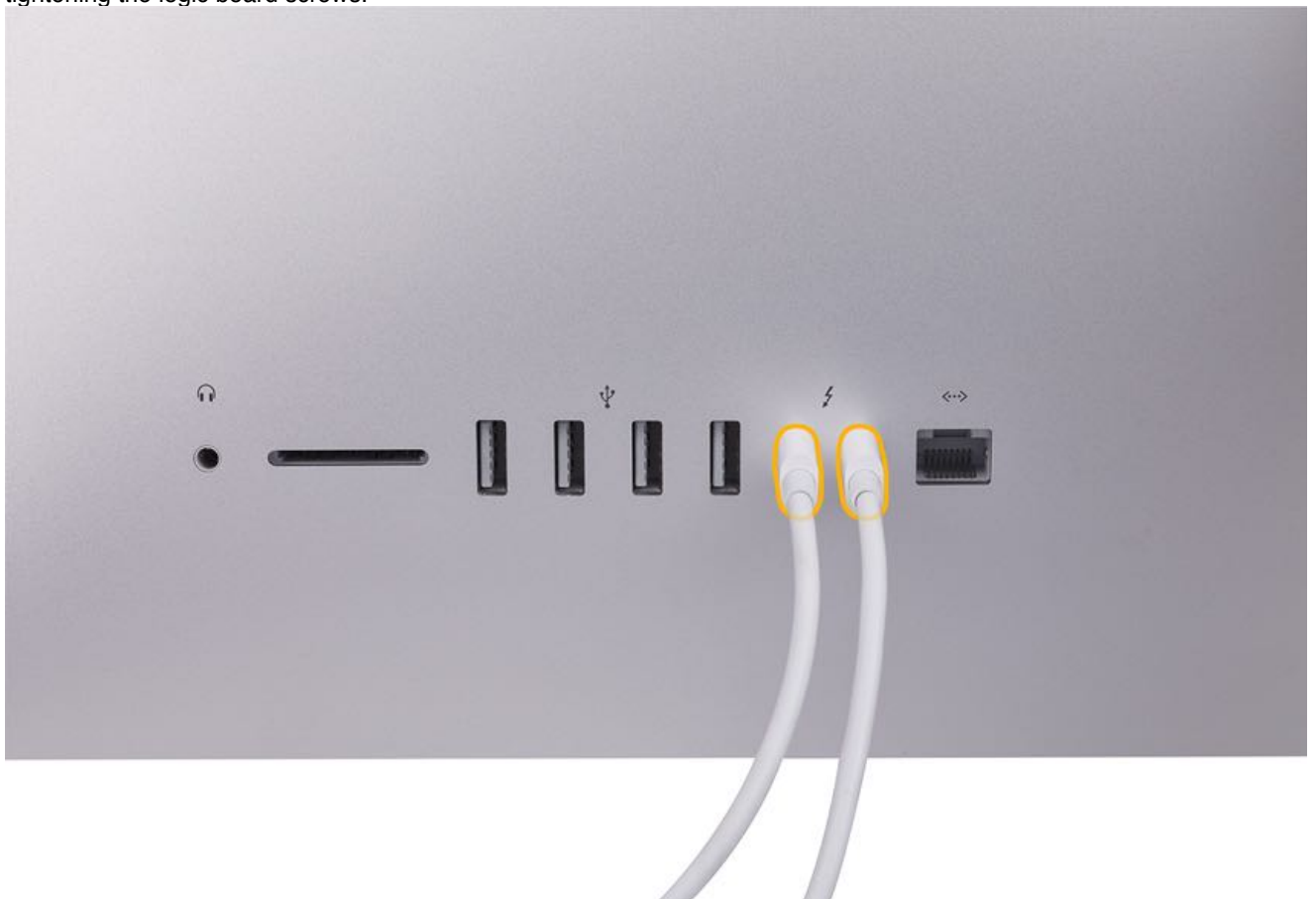


- 6 = One T8 captive screw located in the middle of the logic board (remains attached)

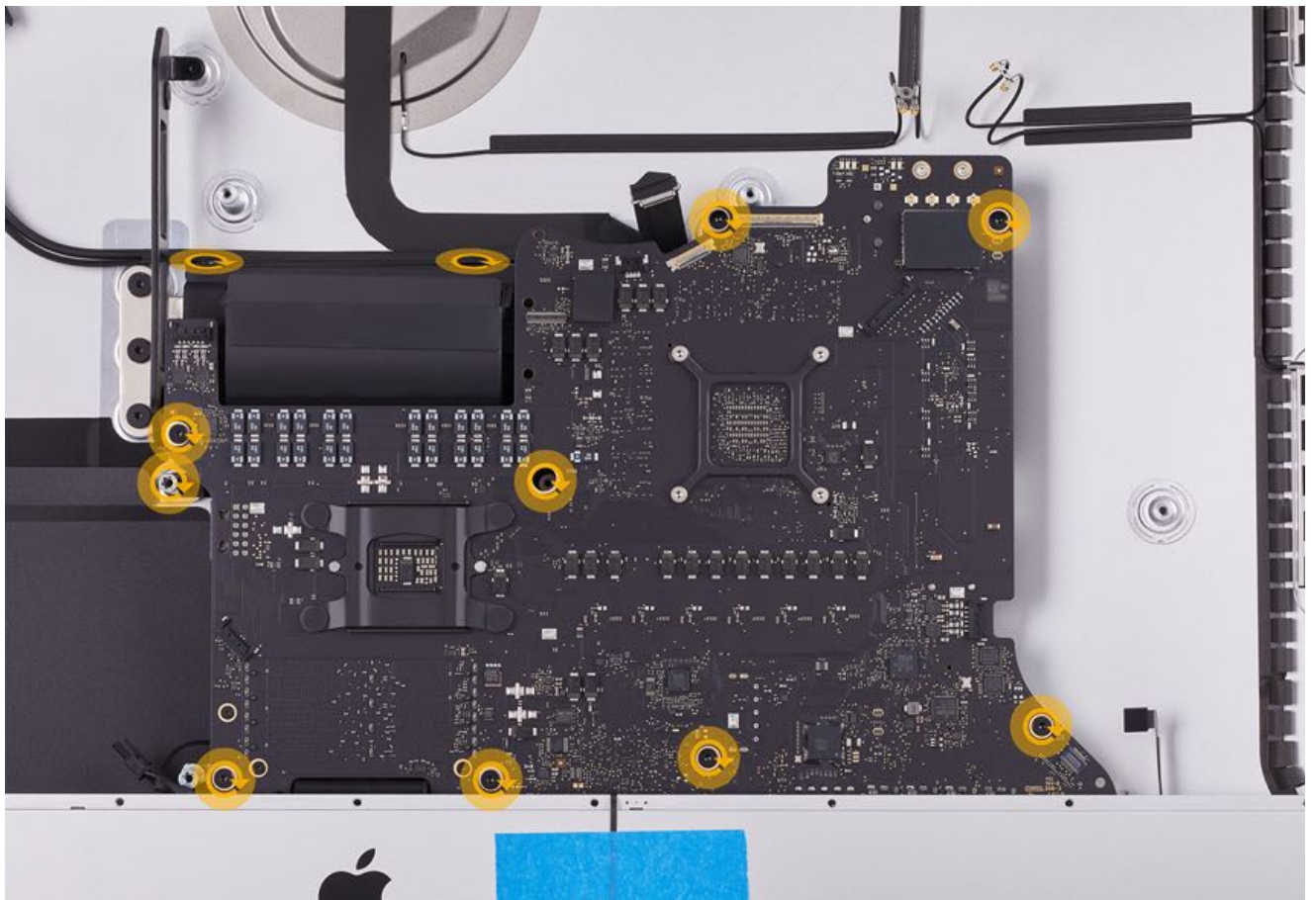
Screw locations:



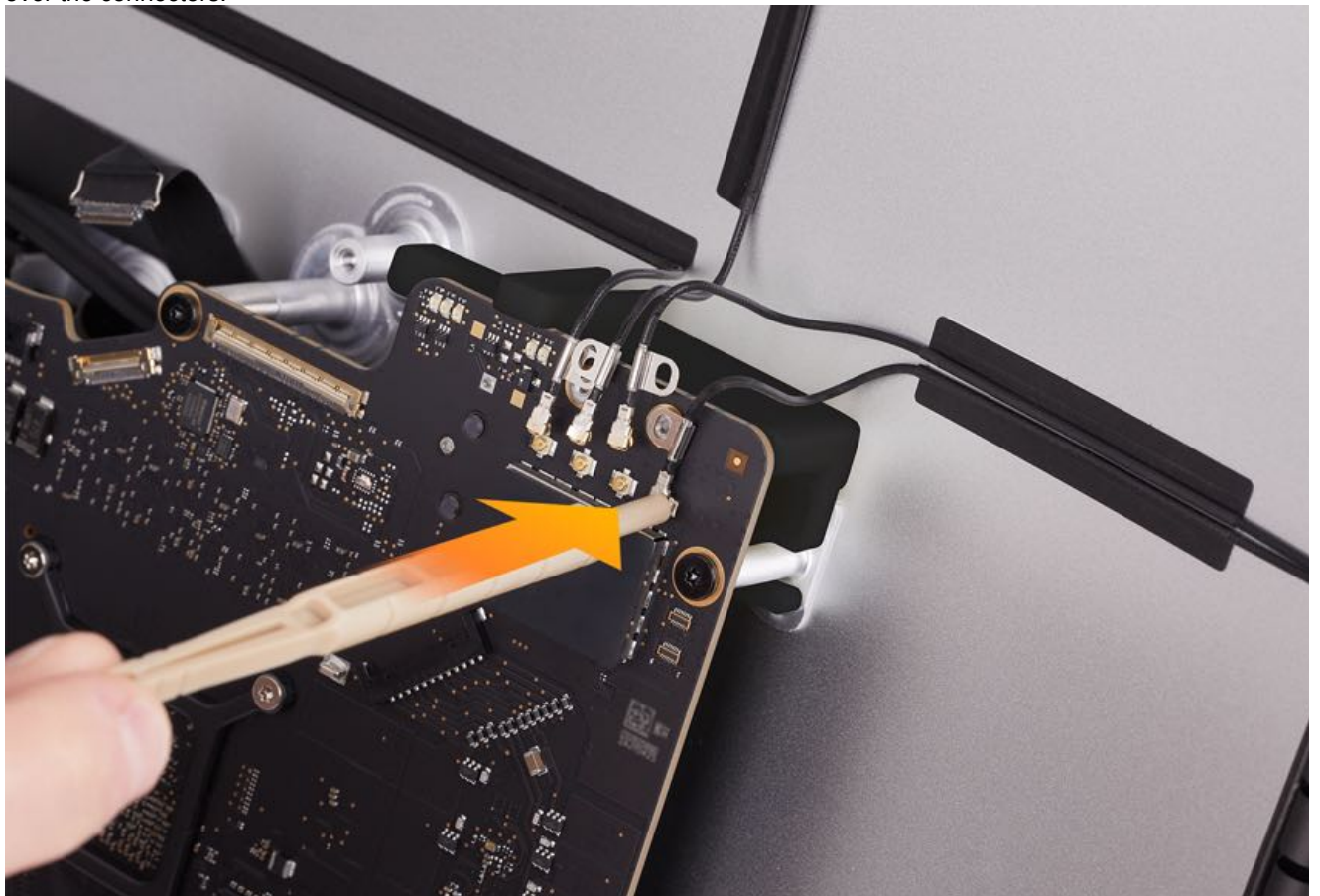
6. To ensure correct logic board alignment with the rear housing, plug in a Thunderbolt cable or an SD card before fully tightening the logic board screws.



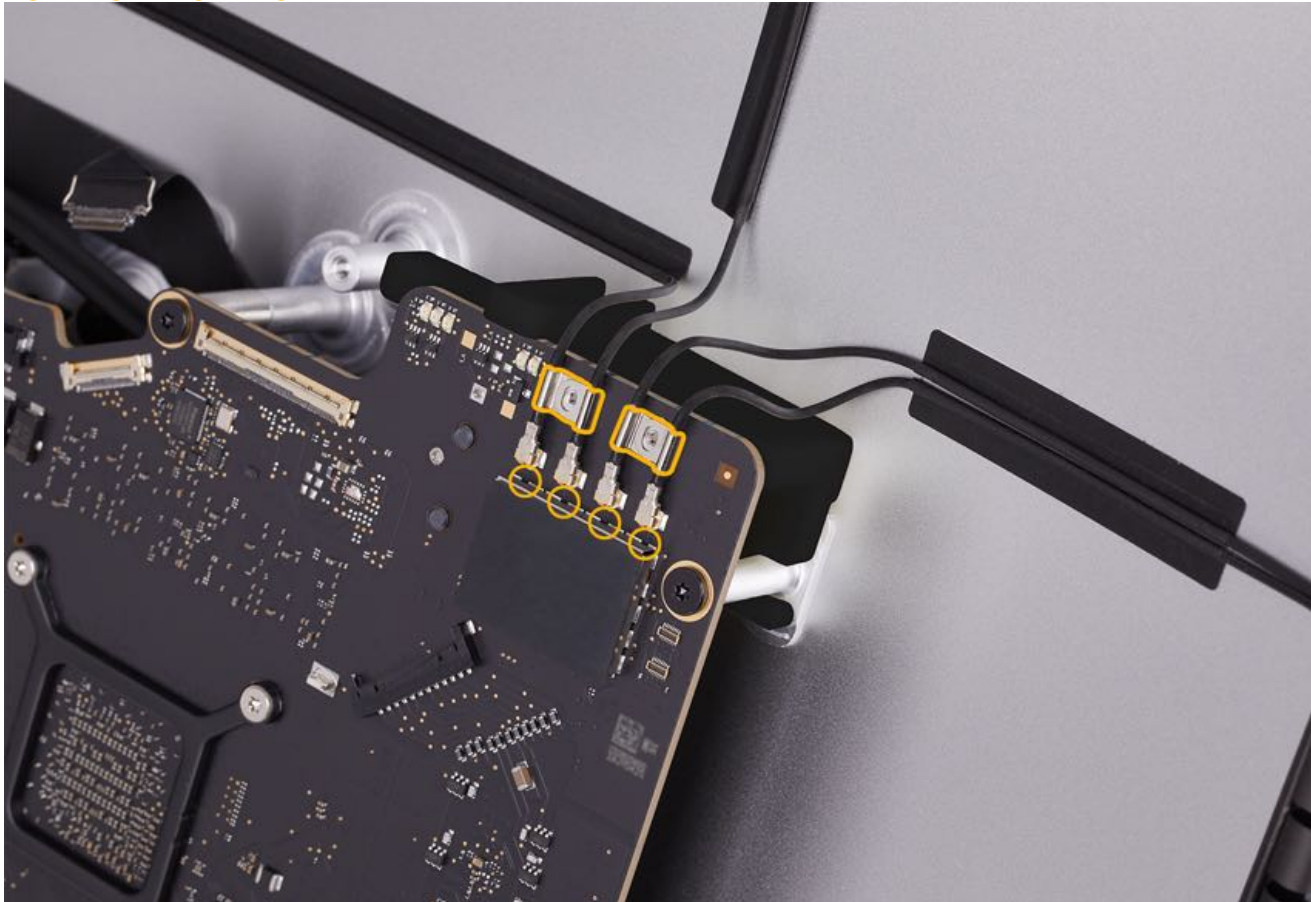
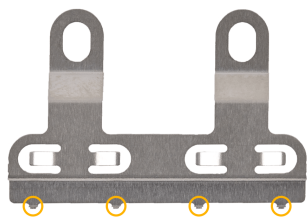
7. Once the logic board is properly aligned, fully tighten the logic board screws.



8. Slide the wireless card support tool into place between the rear housing and the logic board. Reconnect the antennas to the logic board using the flat side of the antenna tool. If necessary, use ESD-safe tweezers to align the antennas over the connectors.

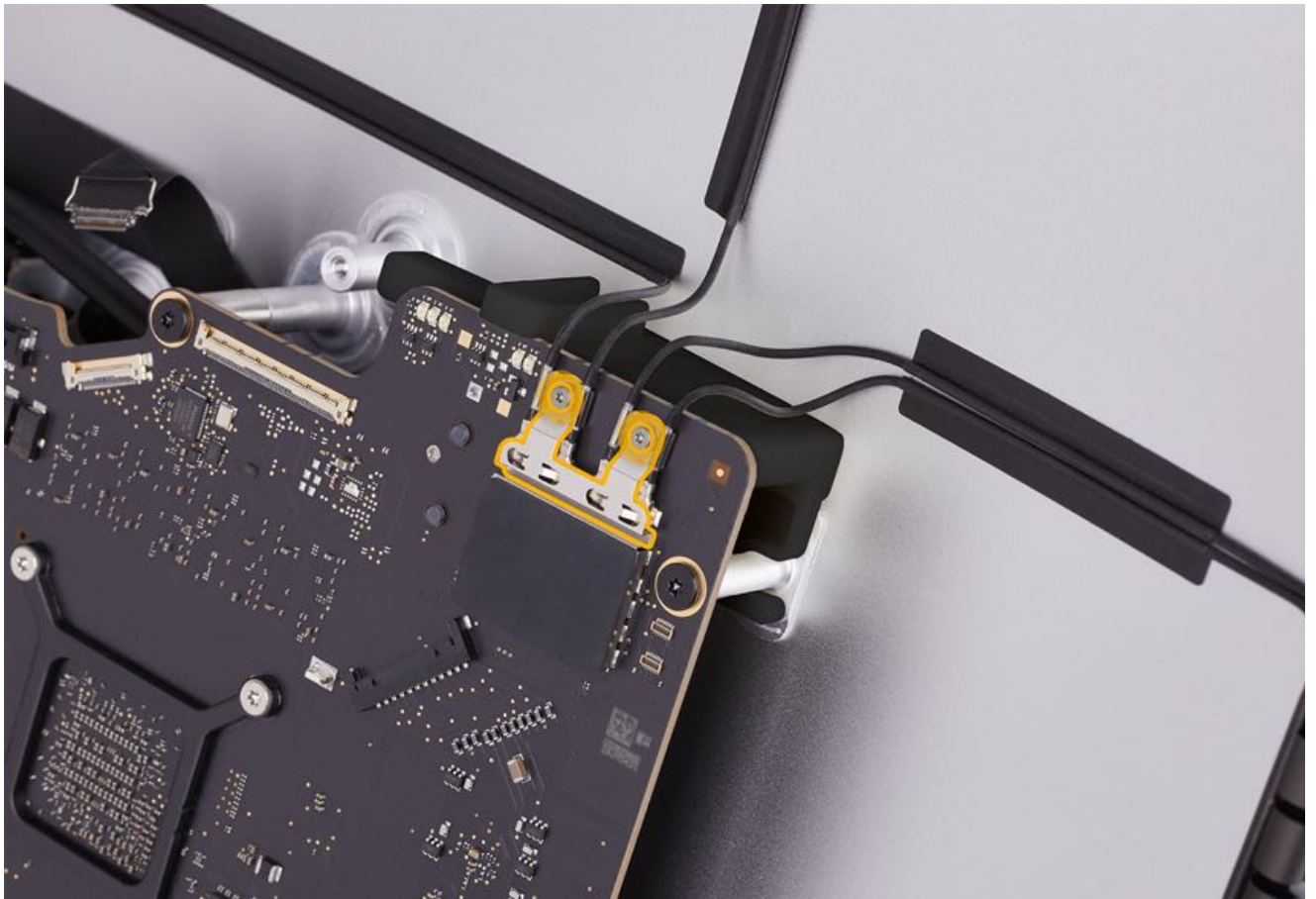


9. Insert the antenna cowling (923-02330) at an angle to engage the teeth in the slots. Then position the antenna cowling over the connectors to reinstall it.

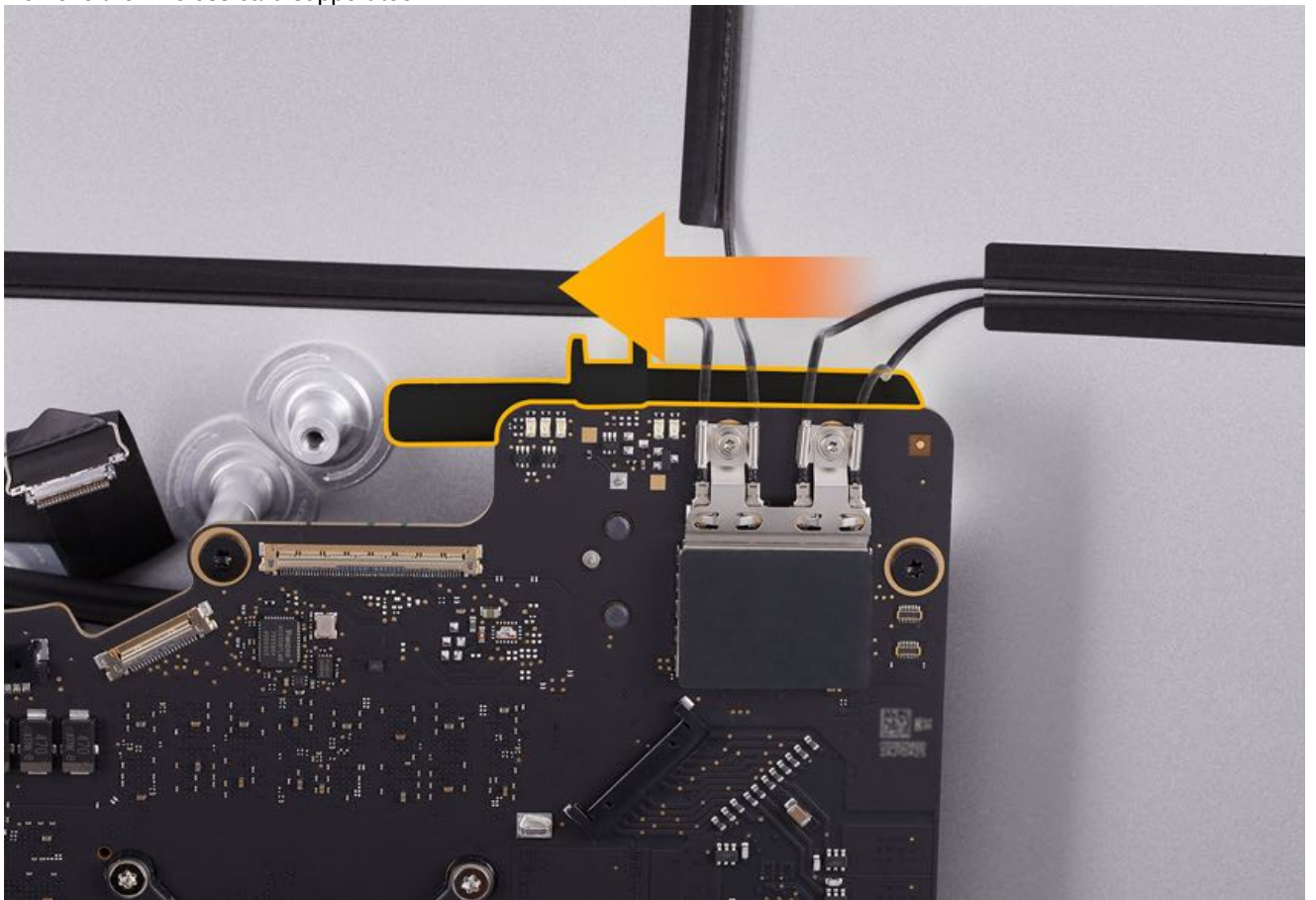


10. Reinstall the two T5 (923-02294) screws in the antenna cowl.





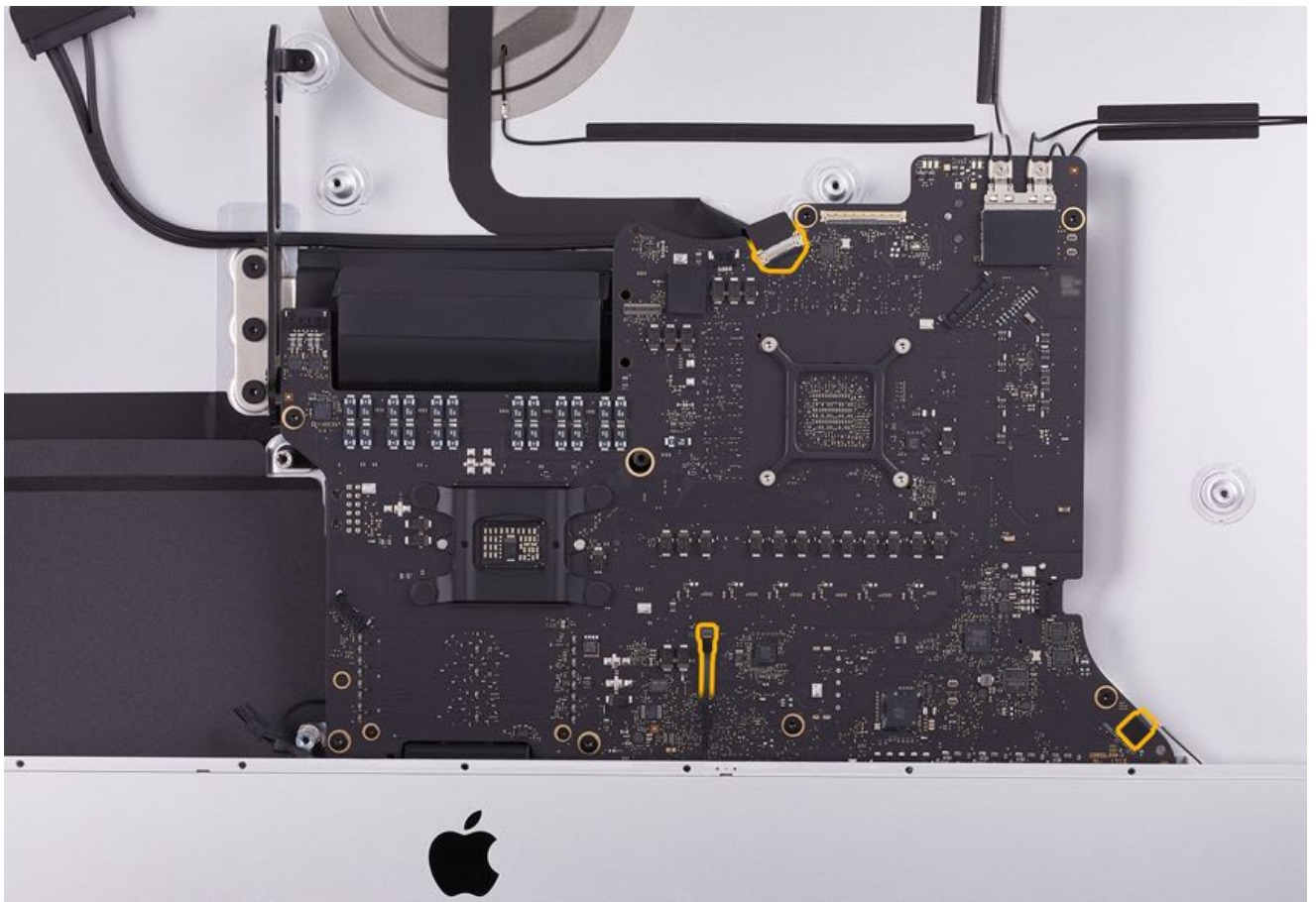
11. Remove the wireless card support tool.



12. Reconnect the following cables to the logic board:

- Camera cable
- Audio cable
- Microphone flex cable

Caution: Be careful not to damage the microphone flex cable when removing the tape.



13. Reinstall the [power supply](#).
14. Reinstall the [right speaker](#).
15. Reinstall the [hard drive](#).
16. Reinstall the [left speaker](#).
17. Reinstall the [fan](#).
18. Reinstall the [display](#).



If installing a replacement logic board:

Apply a new Ethernet ID label (included in box with new logic board) to the bottom of the stand or underside of VESA mount adapter.

Run Blank Board Serializer (BBS) to set the computer's serial number to the new logic board.

Note: When using Blank Board Serializer in AST 2, ensure that the unit under test (UUT) and the AST server are connected to the same network, and that the AST server has the latest software version installed.

For more information about AST and AST 2, supported Mac models, and instructions for downloading and using these utilities, see [OP476: Latest Apple Service Toolkit download links and documentation](#).

iMac (Retina 5K, 27-inch, 2019) Hard Drive Data and Power Cable

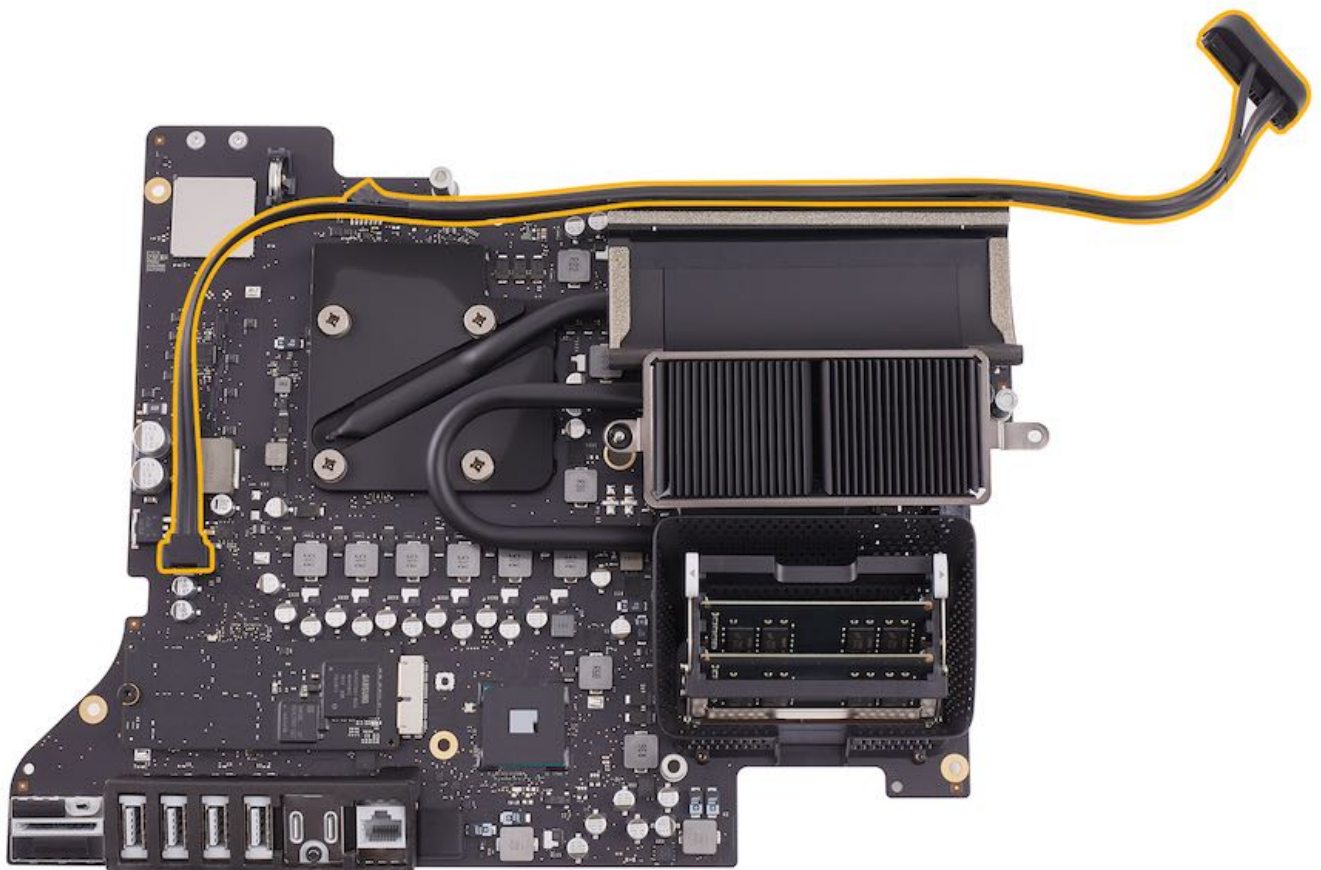
First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

For video instruction, refer to [SV247: Hard Drive Cables Replacement Video](#).

Remove:

- [Display](#)
- [Fan](#)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#)
- [Power supply](#)
- [Logic board](#)

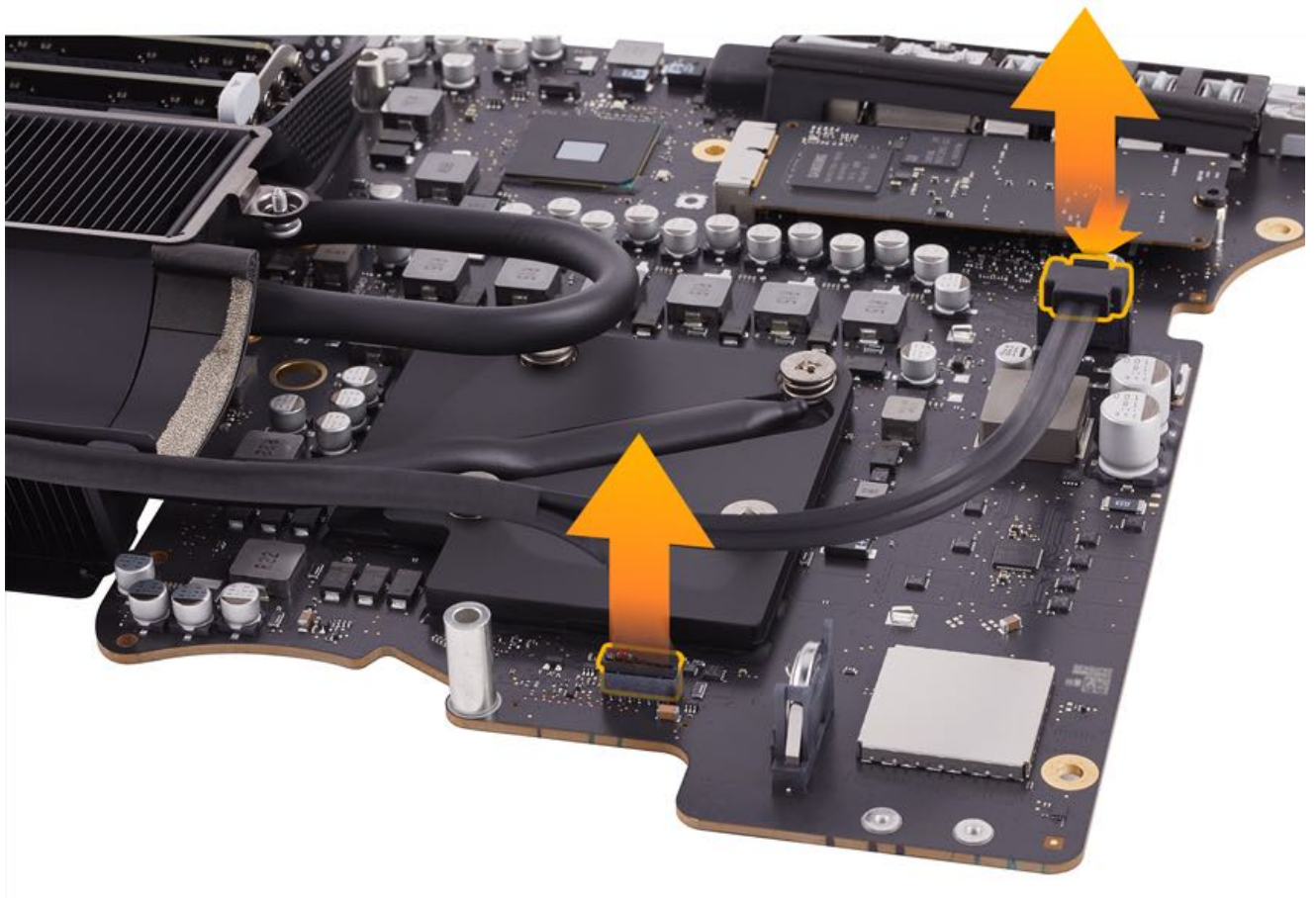


Tools

No tools are required for this procedure.

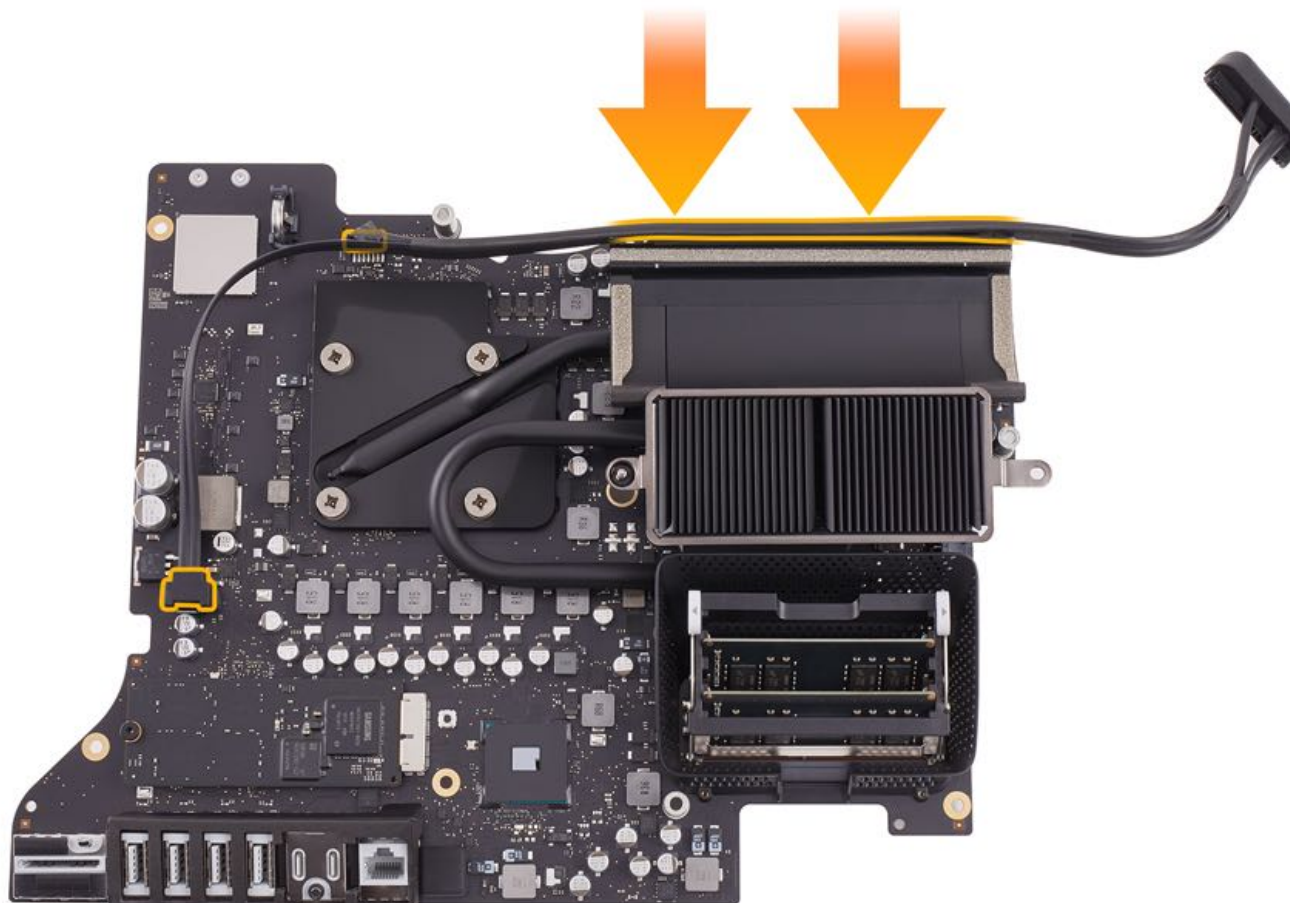
Steps For Removal

1. Pinch the metal clip on the hard drive data cable connector to release the cable from the logic board.
2. Gently pull up the hard drive power cable connector to release the cable from the logic board.



Steps For Reassembly

1. Reinsert the hard drive power and hard drive data connectors into the logic board.
2. Press the cable to readhere to the heat sink. A replacement cable comes with new adhesive. If replacing the cable, remove the adhesive liner and press the cable with the adhesive facedown to adhere it to the heat sink.



3. Reinstall the [logic board](#).
4. Reinstall the [power supply](#).
5. Reinstall the [right speaker](#).
6. Reinstall the [hard drive](#).
7. Reinstall the [left speaker](#).
8. Reinstall the [fan](#).
9. Reinstall the [display](#).

iMac (Retina 5K, 27-inch, 2019) Flash Storage

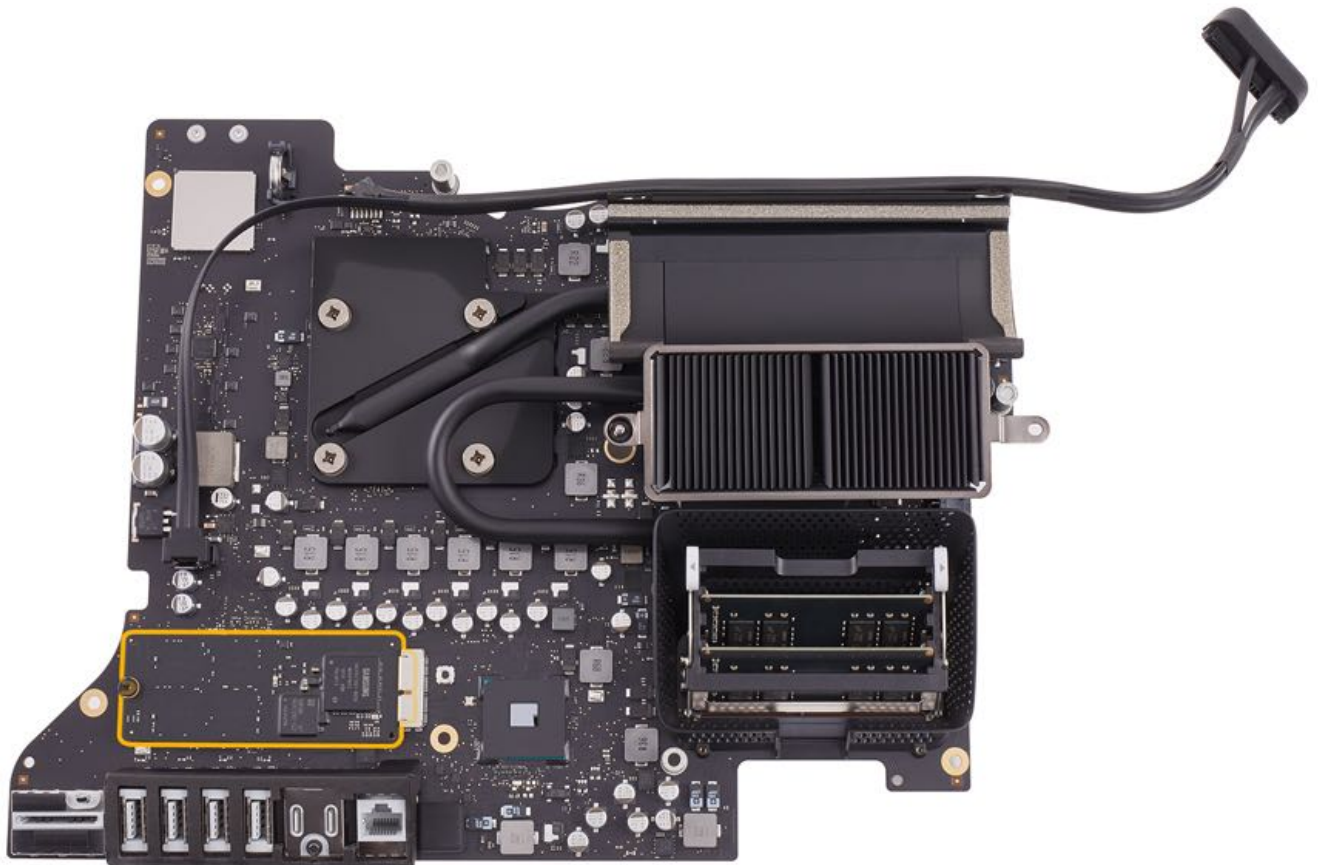
First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

For video instruction, refer to [SV248: Flash Storage Replacement Video](#).

Remove:

- [Display](#)
- [Fan](#)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#)
- [Power supply](#)
- [Logic board](#)



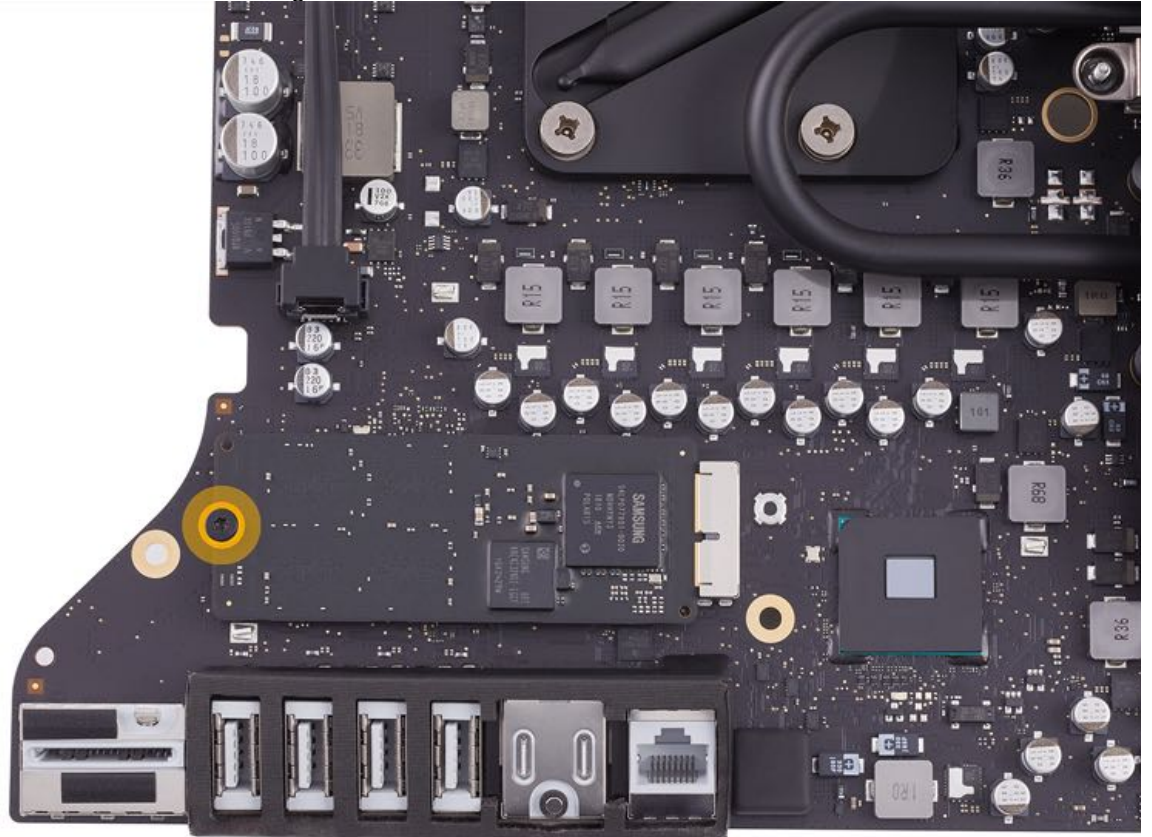
Tools

1. Torx T8 screwdriver



Steps For Removal

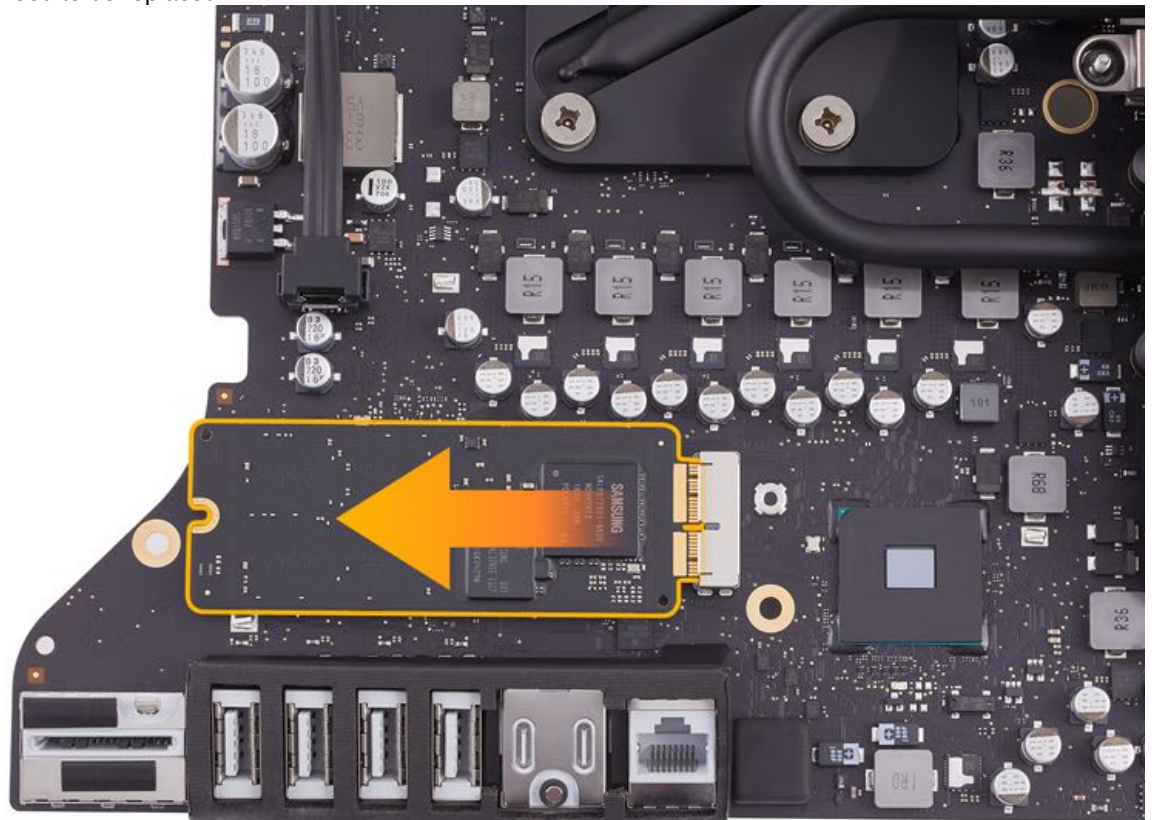
1. Remove one T8 screw from the flash storage card.



2. Pull the flash storage straight out of the connector on the logic board.



Caution: Do not lift the flash storage at an angle when removing it from the connector. If the connector is damaged, the logic board will need to be replaced.

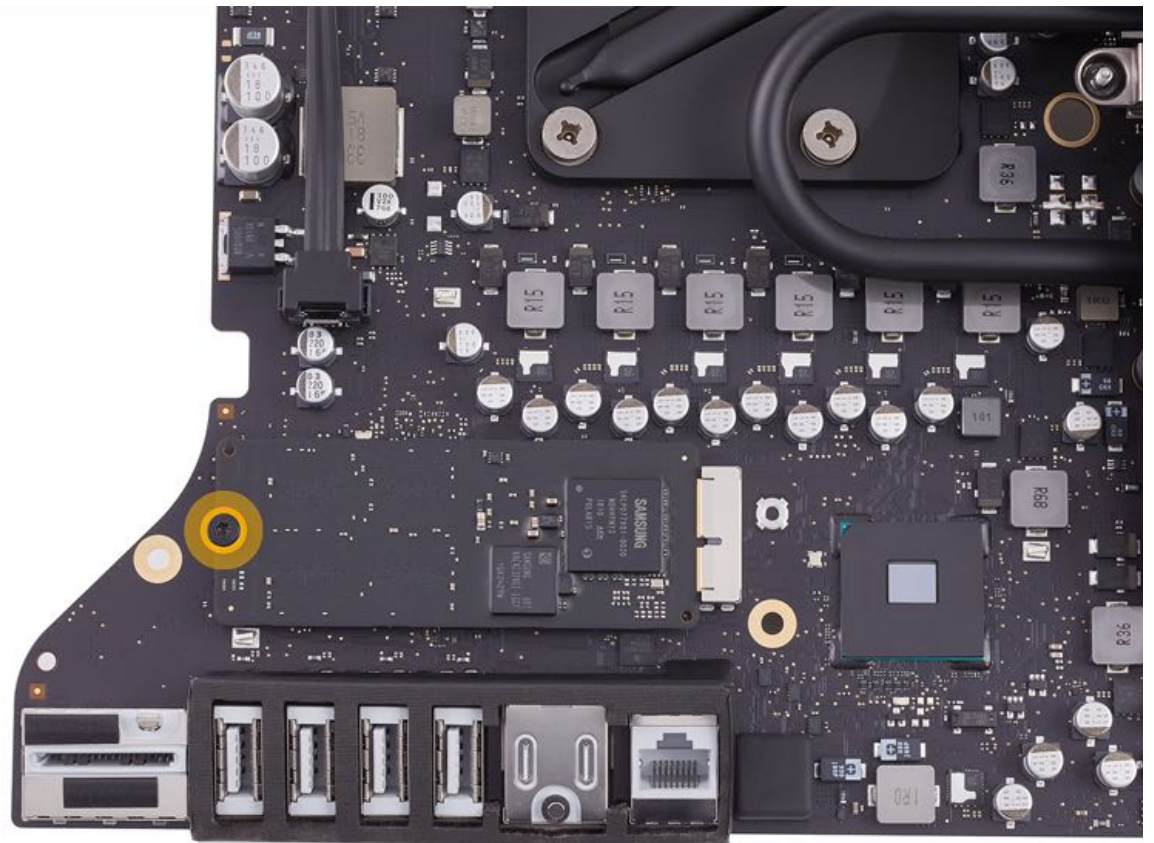


Steps For Reassembly

1. Insert the flash storage straight into the connector on the logic board.

2. Reinstall the one T8 (923-0336) screw.





3. Reinstall the [logic board](#).
4. Reinstall the [power supply](#).
5. Reinstall the [right speaker](#).
6. Reinstall the [hard drive](#).
7. Reinstall the [left speaker](#).
8. Reinstall the [fan](#).
9. Reinstall the [display](#).

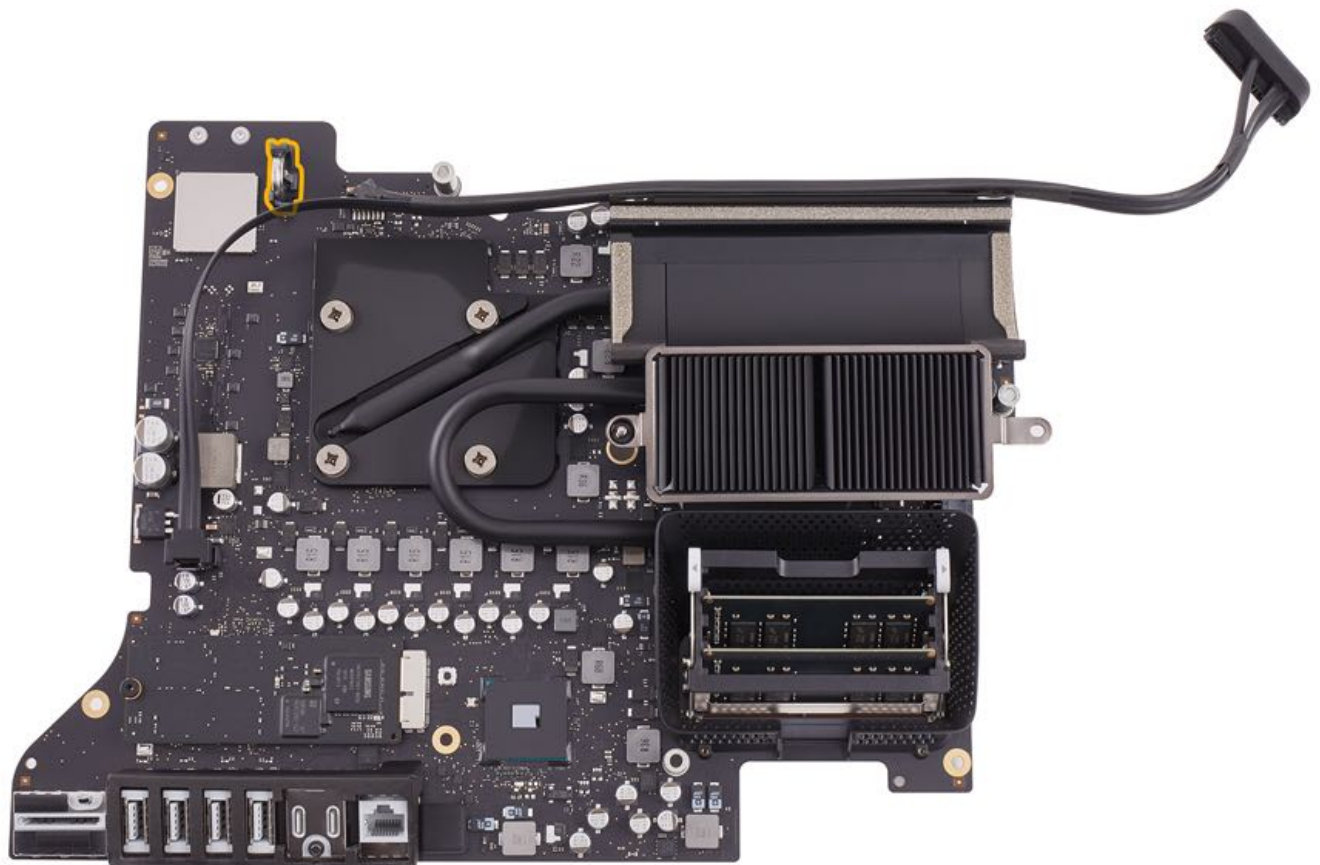
iMac (Retina 5K, 27-inch, 2019) Battery

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

Remove:

- [Display](#)
- [Fan](#)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#)
- [Power supply](#)
- [Logic board](#)

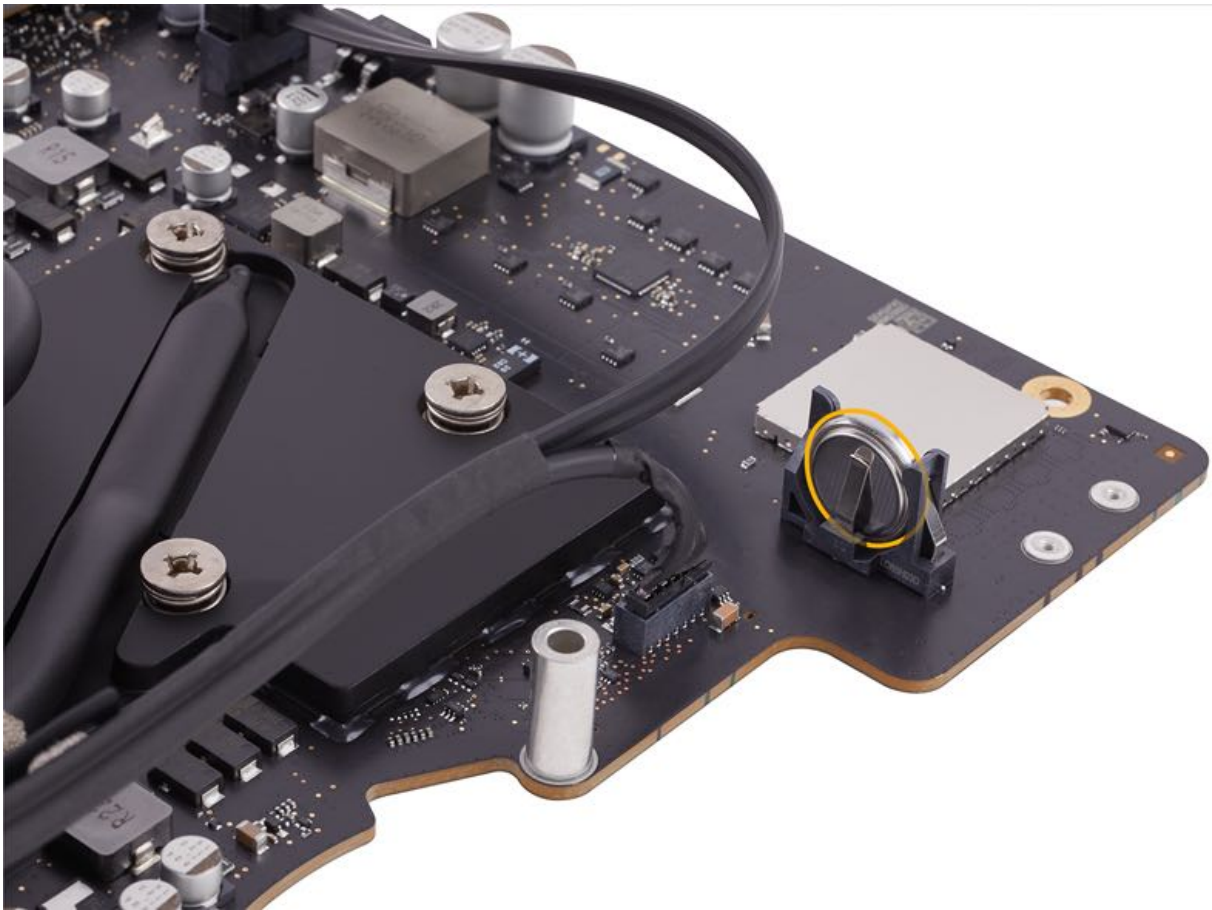


Tools

No tools are required for this procedure.

Steps For Removal

1. Grasp the battery with two fingers and pull it up from the socket to remove it.



Steps For Reassembly



Warning: If the battery is installed incorrectly or replaced by an incorrect battery, there is a risk of explosion. Dispose of used batteries according to local environmental laws and guidelines.

1. Check that the battery socket is open and free of dust.
2. Insert the battery into the socket with the negative side (no markings) facing the metal clip.



3. Reinstall the [logic board](#).
4. Reinstall the [power supply](#).
5. Reinstall the [right speaker](#).
6. Reinstall the [hard drive](#).
7. Reinstall the [left speaker](#).
8. Reinstall the [fan](#).
9. Reinstall the [display](#).

Note: Effective immediately, some coin cell batteries used on Mac systems are now available only from electronics parts distributors (for example, MCM). If the coin battery needs to be replaced, please order it from an electronics parts distributor. BR2032 and CR2032 batteries have the same form factor and nominal voltage. However, BR2032 batteries have a lower self-discharge rate and broader operating temperature range than CR2032 batteries for longer shelf and service life.

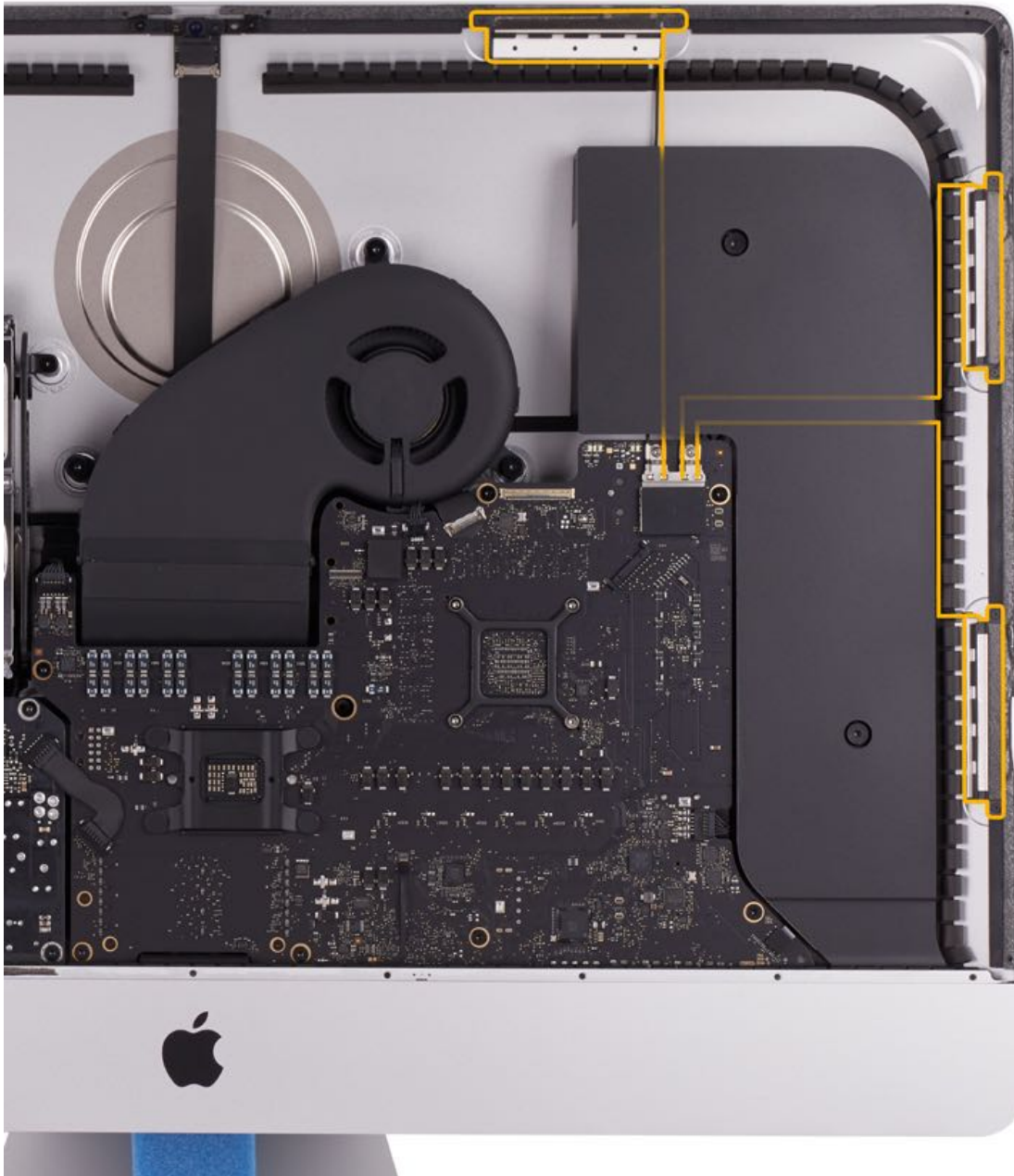
iMac (Retina 5K, 27-inch, 2019) Bluetooth and WiFi Antennas

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

Remove:

- [Display](#)
- [Right speaker](#)



Tools

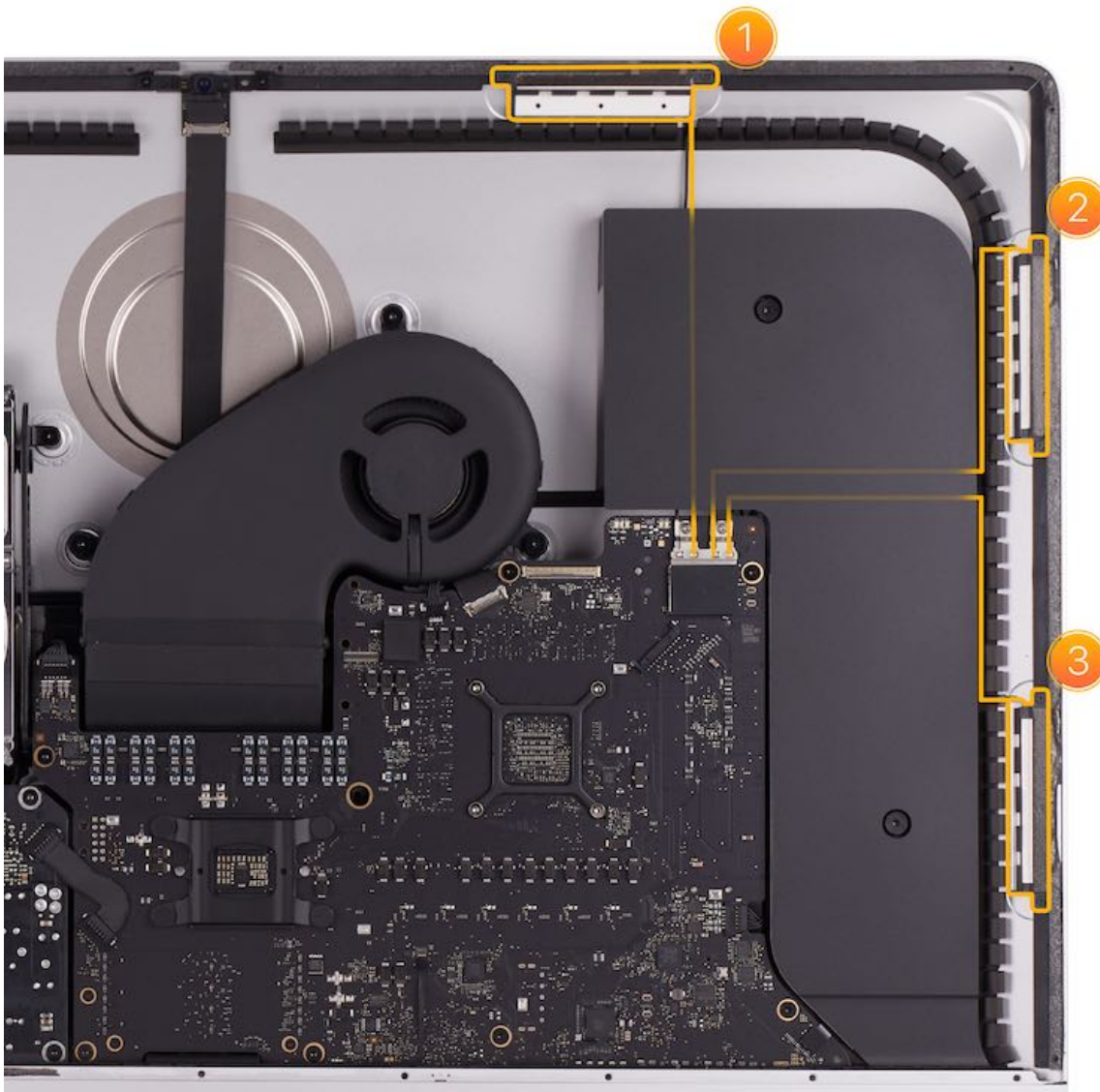
1. iMac service wedge
2. Torx T4 screwdriver
3. Torx T5 screwdriver
4. Antenna tool (923-01322)
5. Black stick
6. Wireless card support tool (923-03085)



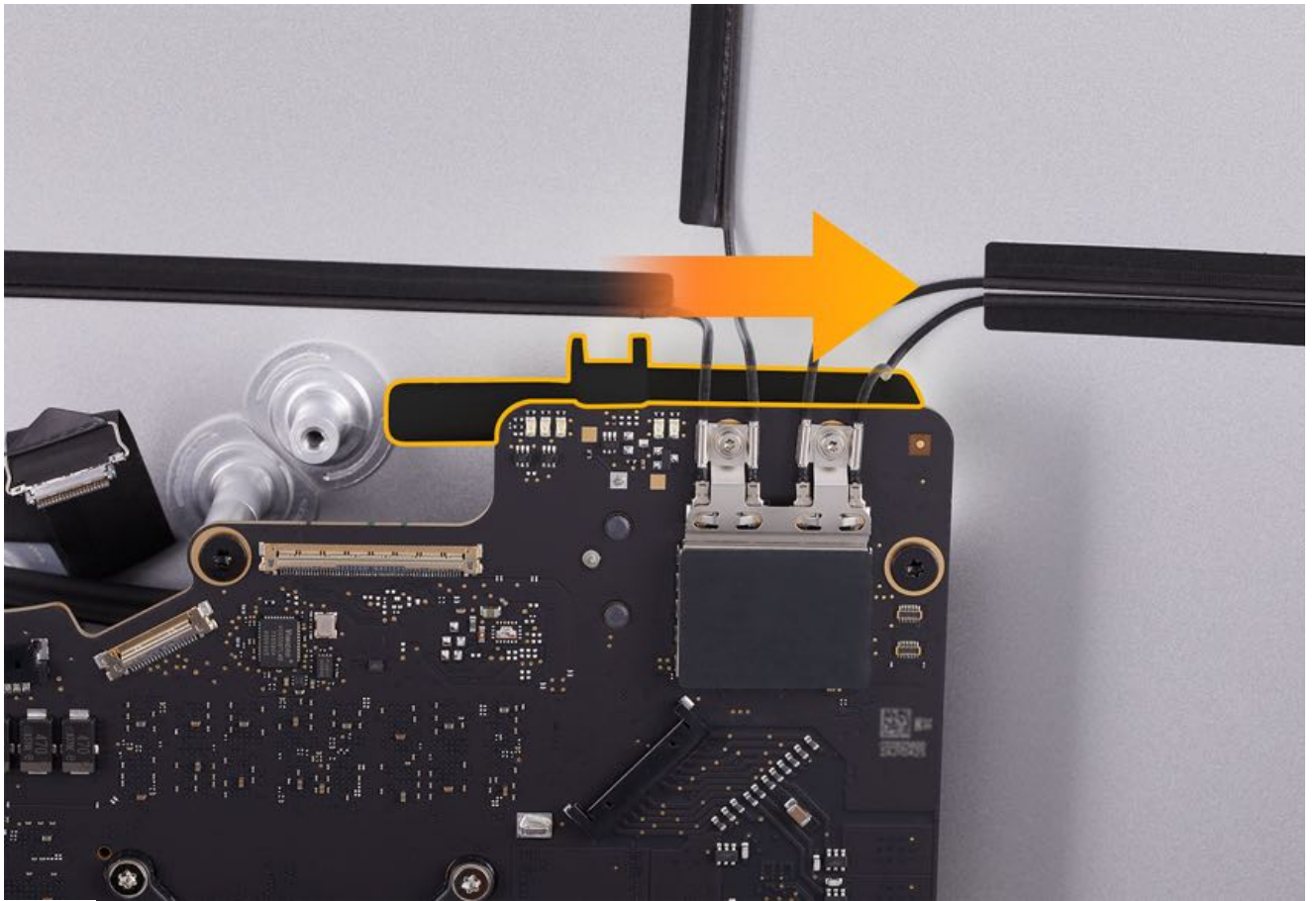
Steps For Removal

Important: The procedure is the same for all three antennas. Refer to the following image to determine the location and cable routing of the antenna you intend to replace.

- 1 = Bluetooth
- 2 = Middle WiFi
- 3 = Lower WiFi



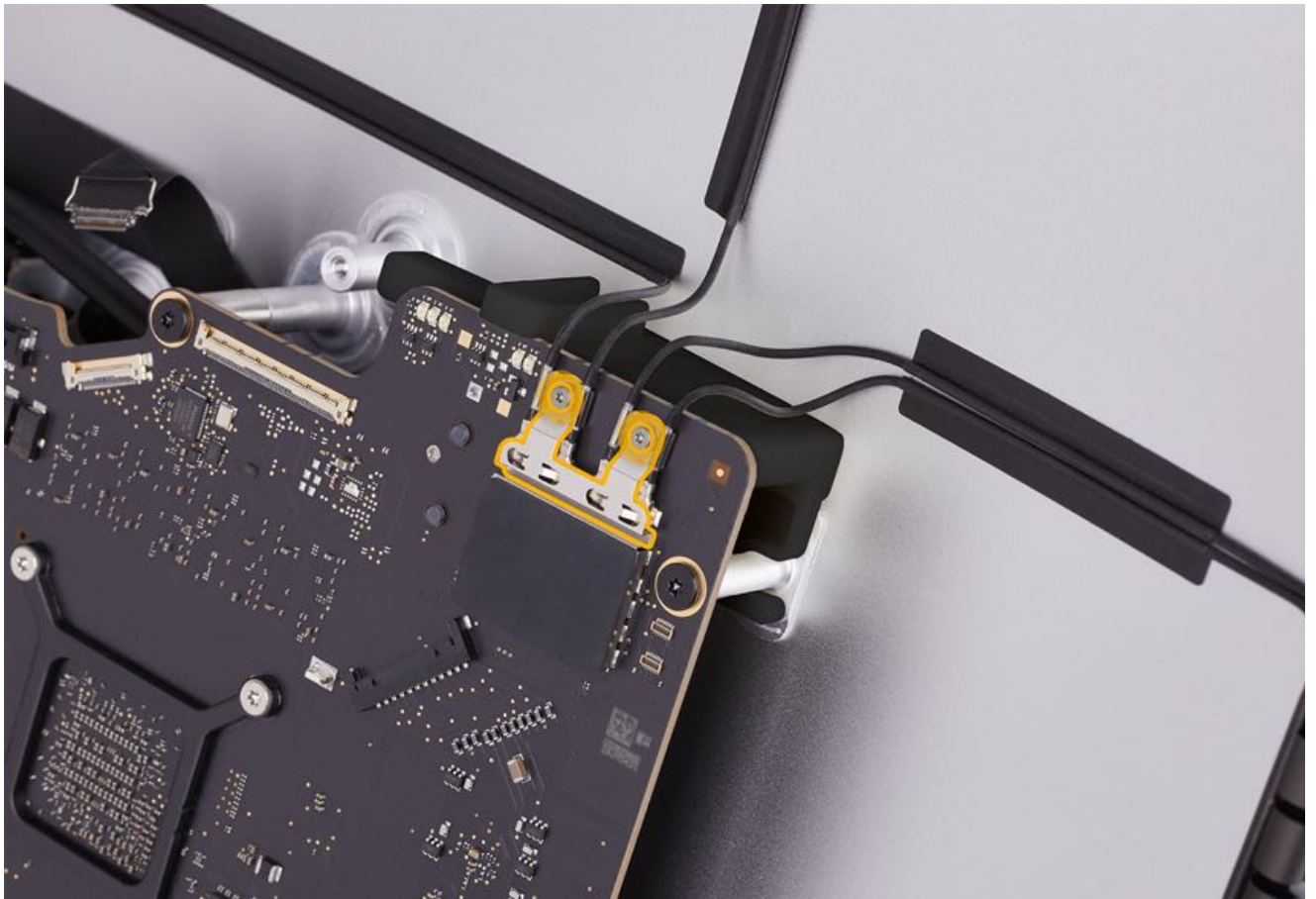
1. Grasp the wireless card support tool handle, lower the tool onto the logic board, and slide it behind the antenna connectors.



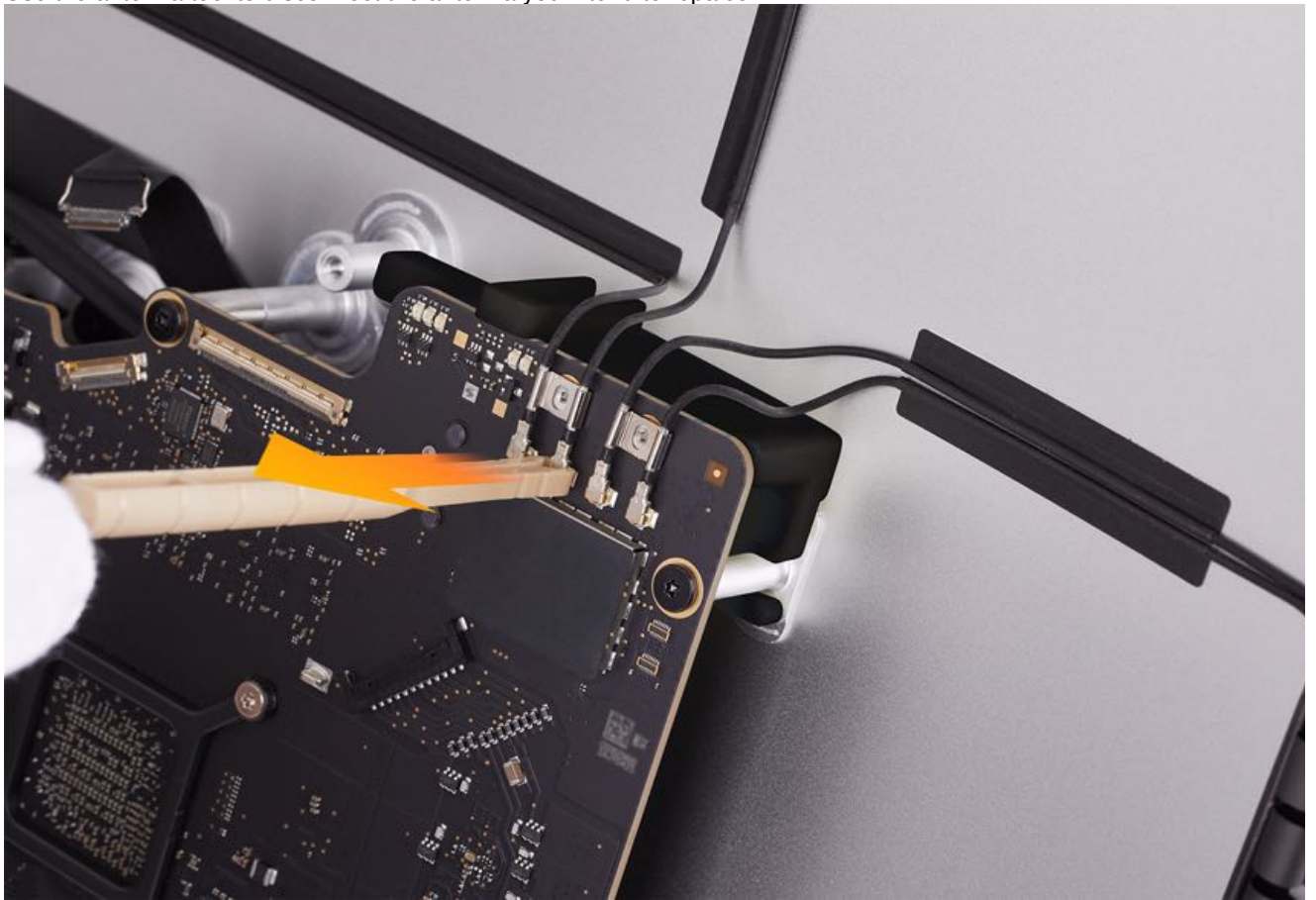
Caution: Avoid the coin cell battery when inserting the tool.



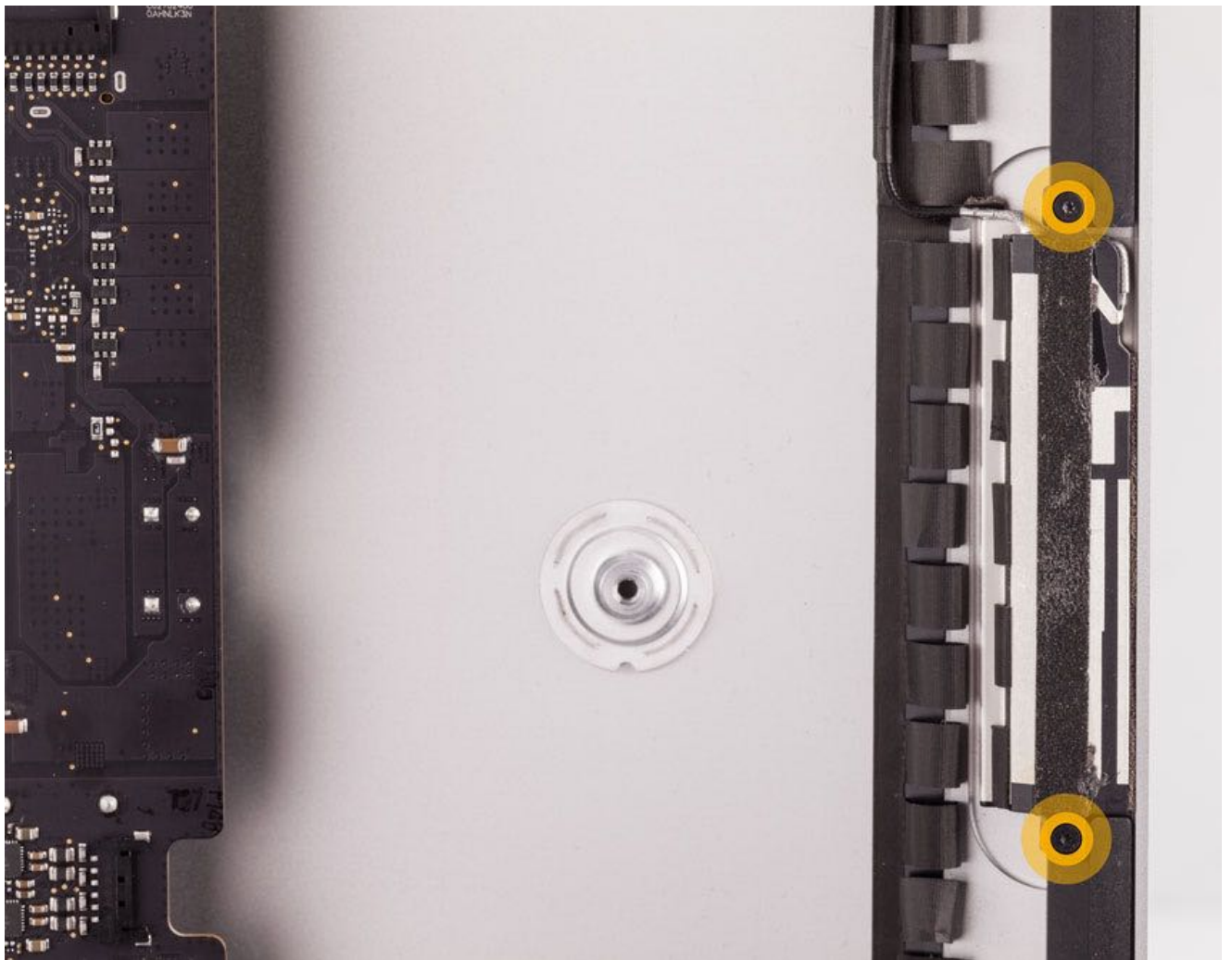
2. Remove the two T5 screws from the antenna cowling. Remove the antenna cowling and save it for reuse



3. Use the antenna tool to disconnect the antenna you intend to replace.



4. Use a black stick or your fingers to gently remove the tape from the rear housing.
5. Remove the two T4 screws that secure the antenna body to the rear housing.

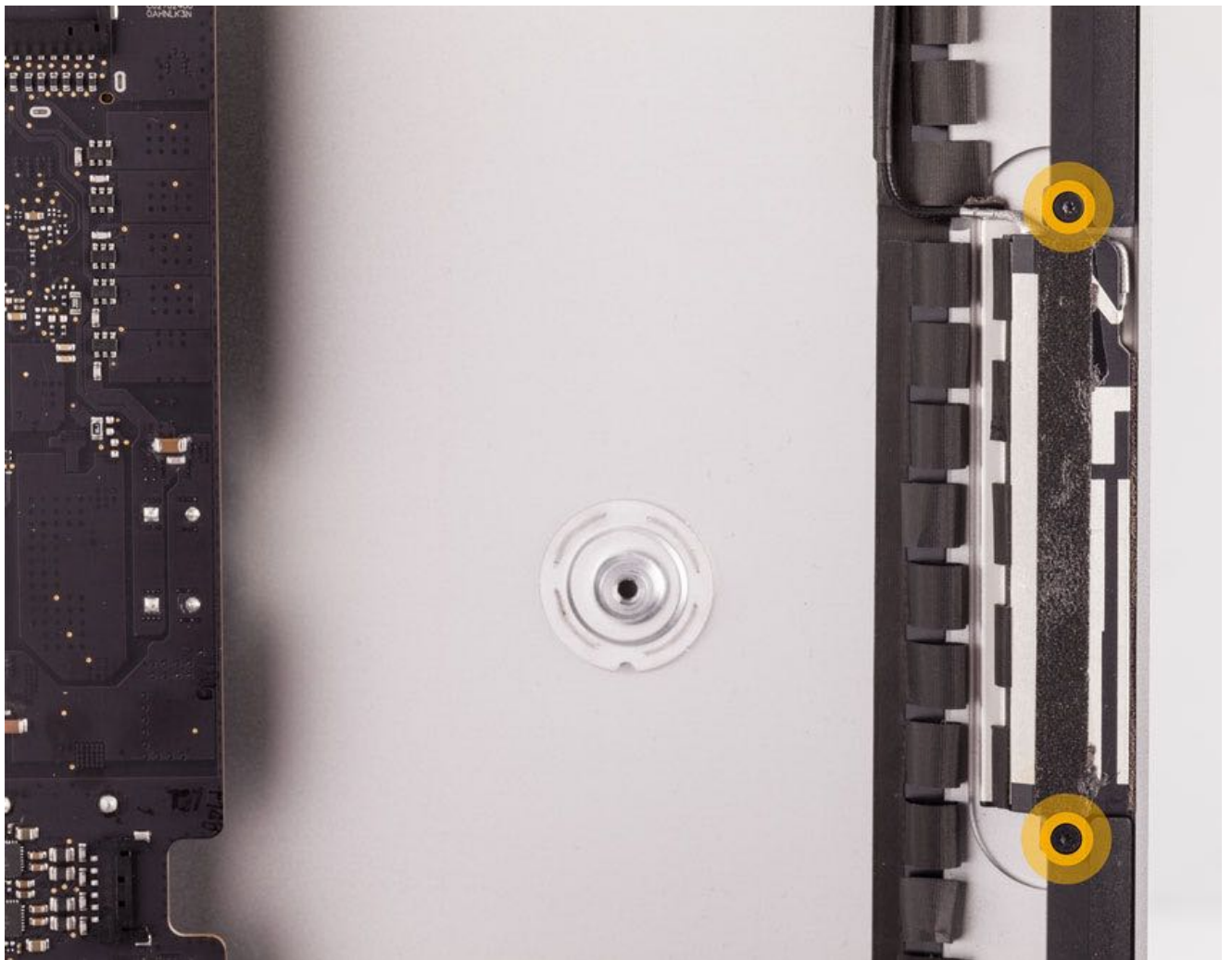


6. Remove the antenna from the rear housing.

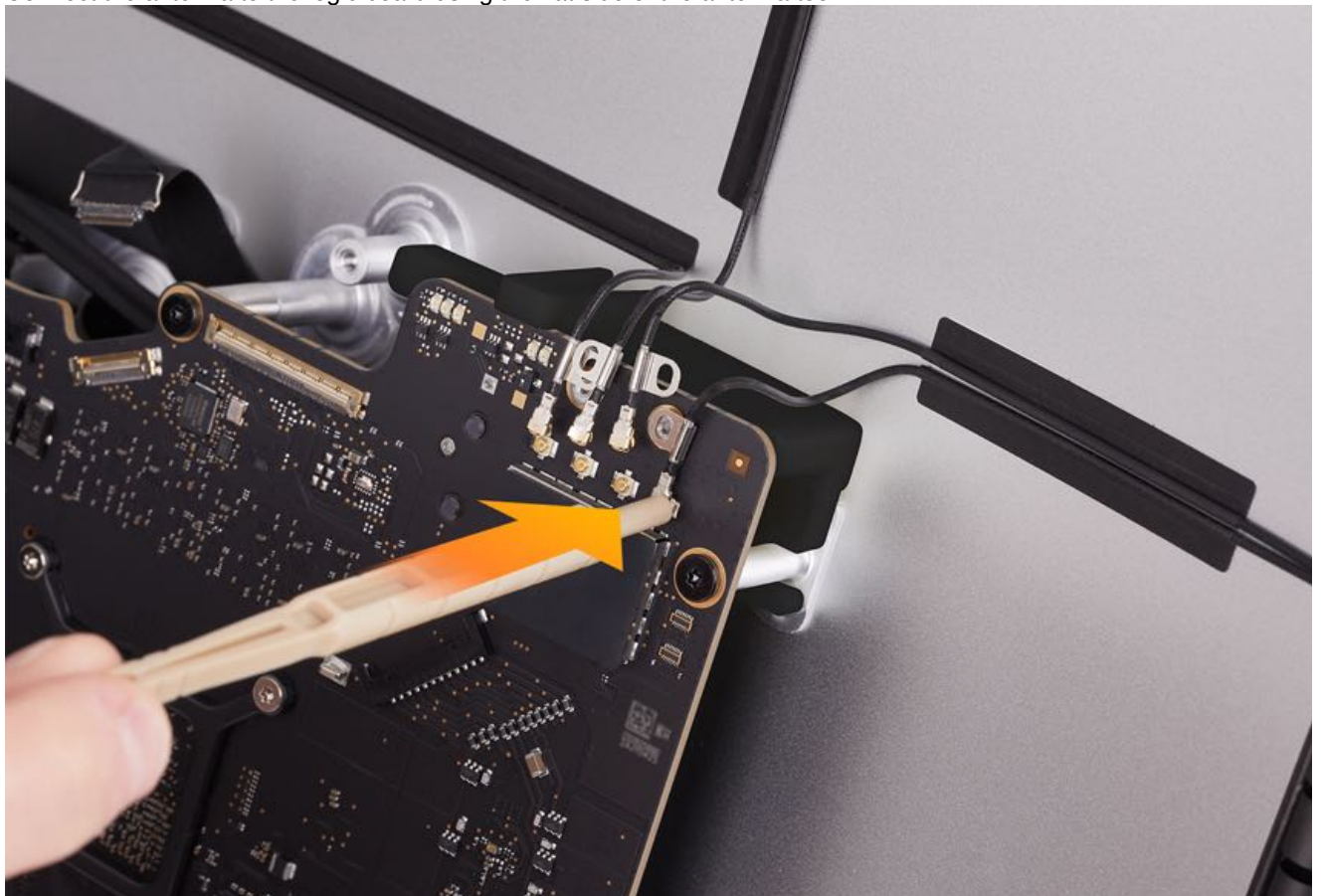
Steps For Reassembly

1. Reinstall two T4 screws (923-00831) to secure the antenna body to the rear housing.

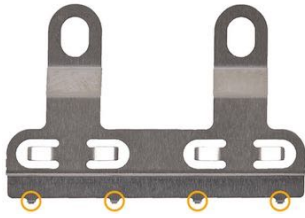




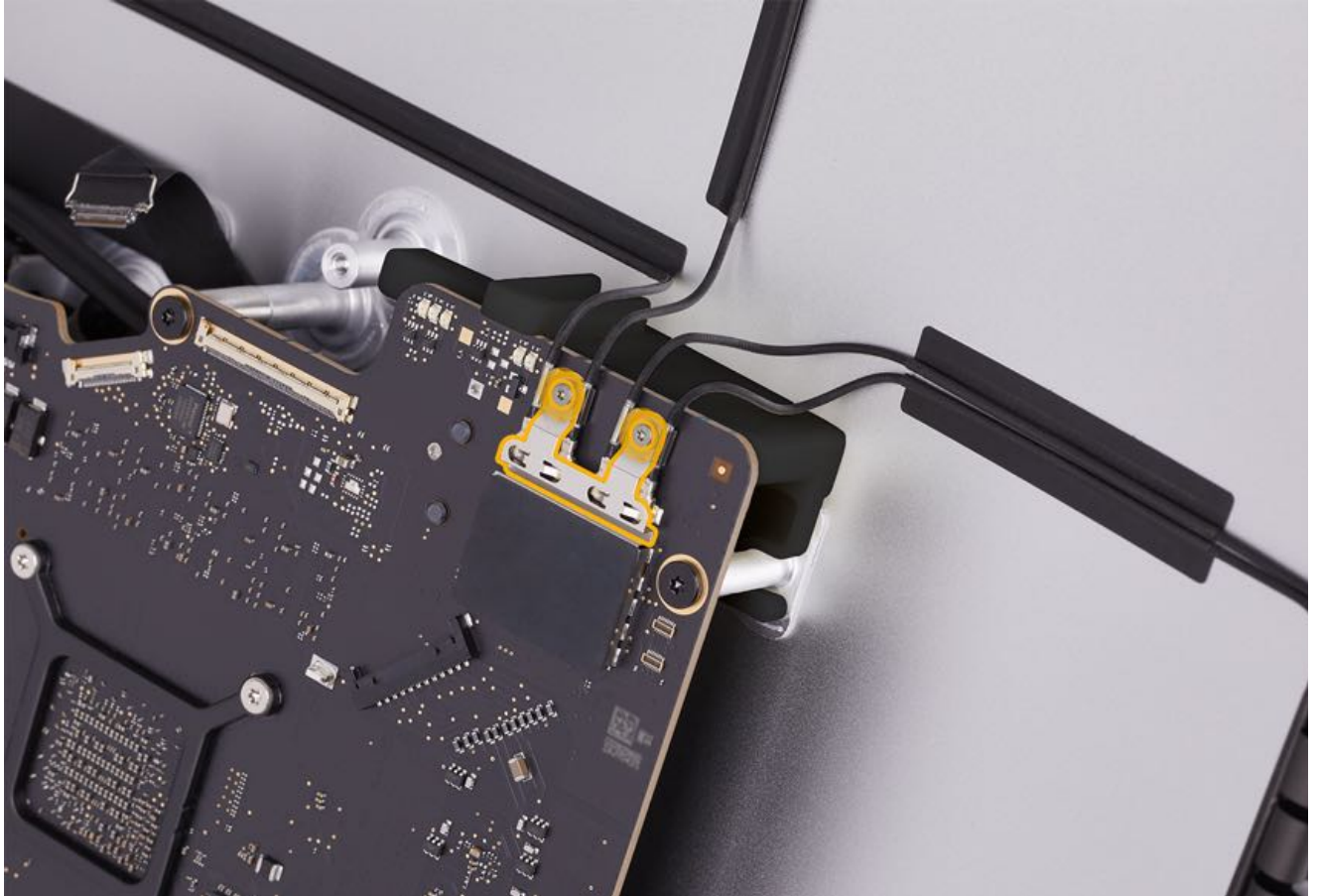
2. Route the antenna cable to the antenna connector on the logic board.
3. Adhere the antenna cable tape to the rear housing.
4. Connect the antenna to the logic board using the flat side of the antenna tool.



5. Insert the antenna cowling at an angle to engage the teeth in the slots. Then position the antenna cowling over the connectors to reinstall it.
 - Cowling: 923-02330



6. Reinstall the two T5 screws in the antenna cowling.
 - T5: 923-02294



7. Remove the wireless card support tool.



8. Check the airloop gasket and use a black stick or tweezers to open any flattened loops.
9. Reinstall the [right speaker](#).
10. Reinstall the [display](#).

iMac (Retina 5K, 27-inch, 2019) Stand

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

Remove:

- [Display](#)
- [Fan](#)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#)
- [Power supply](#)
- [Logic board](#)



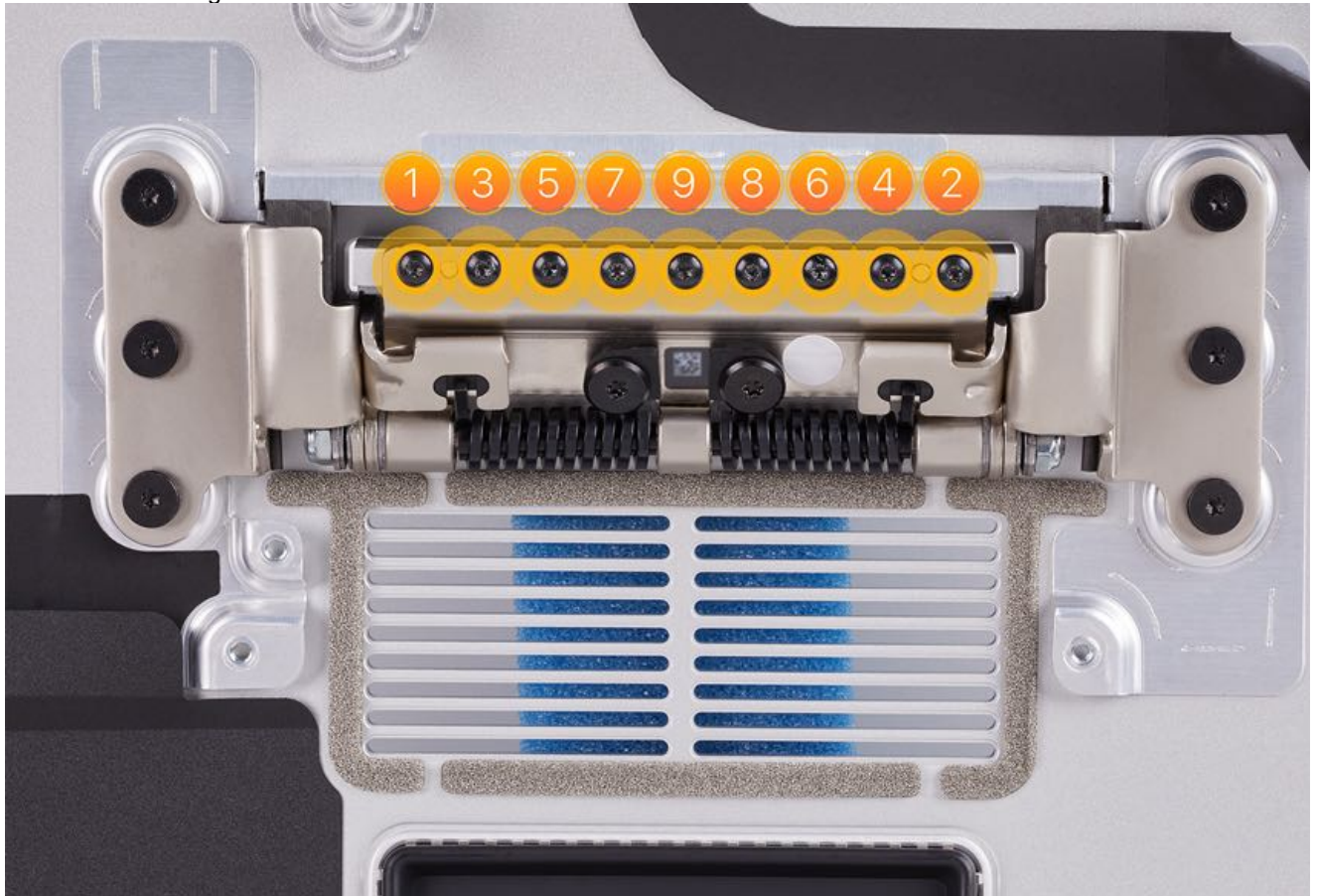
Tools

1. Torx T8 screwdriver
2. iMac service wedge



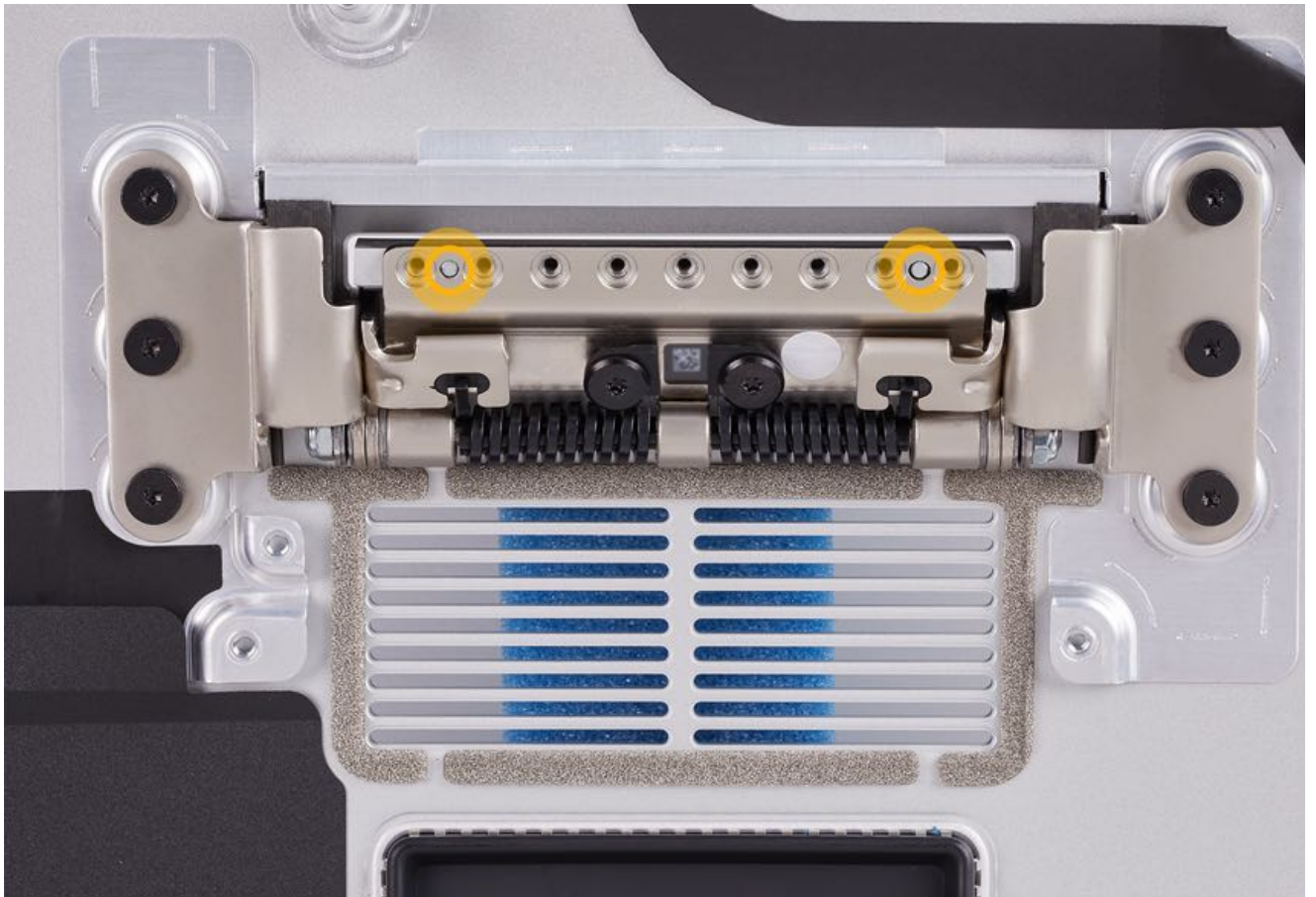
Steps For Removal

1. Remove nine T8 screws in the order shown in the image.
2. Lift the rear housing off of the stand.

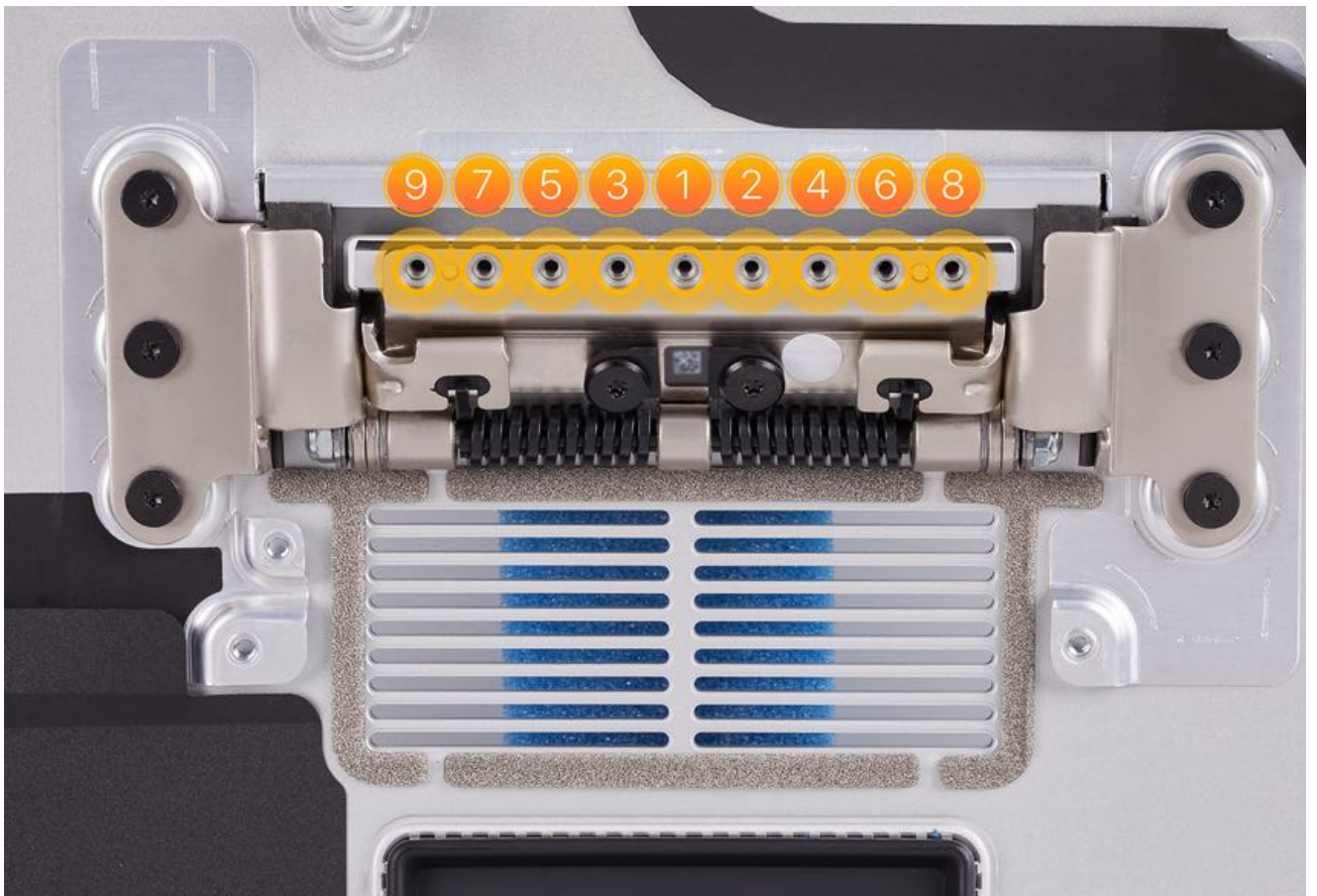


Steps For Reassembly

1. Align the two pins on the stand with the pin holes on the mechanism.



2. Reinstall the nine T8 screws (923-00529) in the order shown in the image.



3. Reinstall the [logic board](#).
4. Reinstall the [power supply](#).
5. Reinstall the [right speaker](#).

6. Reinstall the [hard drive](#).
7. Reinstall the [left speaker](#).
8. Reinstall the [fan](#).
9. Reinstall the [display](#).

iMac (Retina 5K, 27-inch, 2019) Mechanisms

First Steps

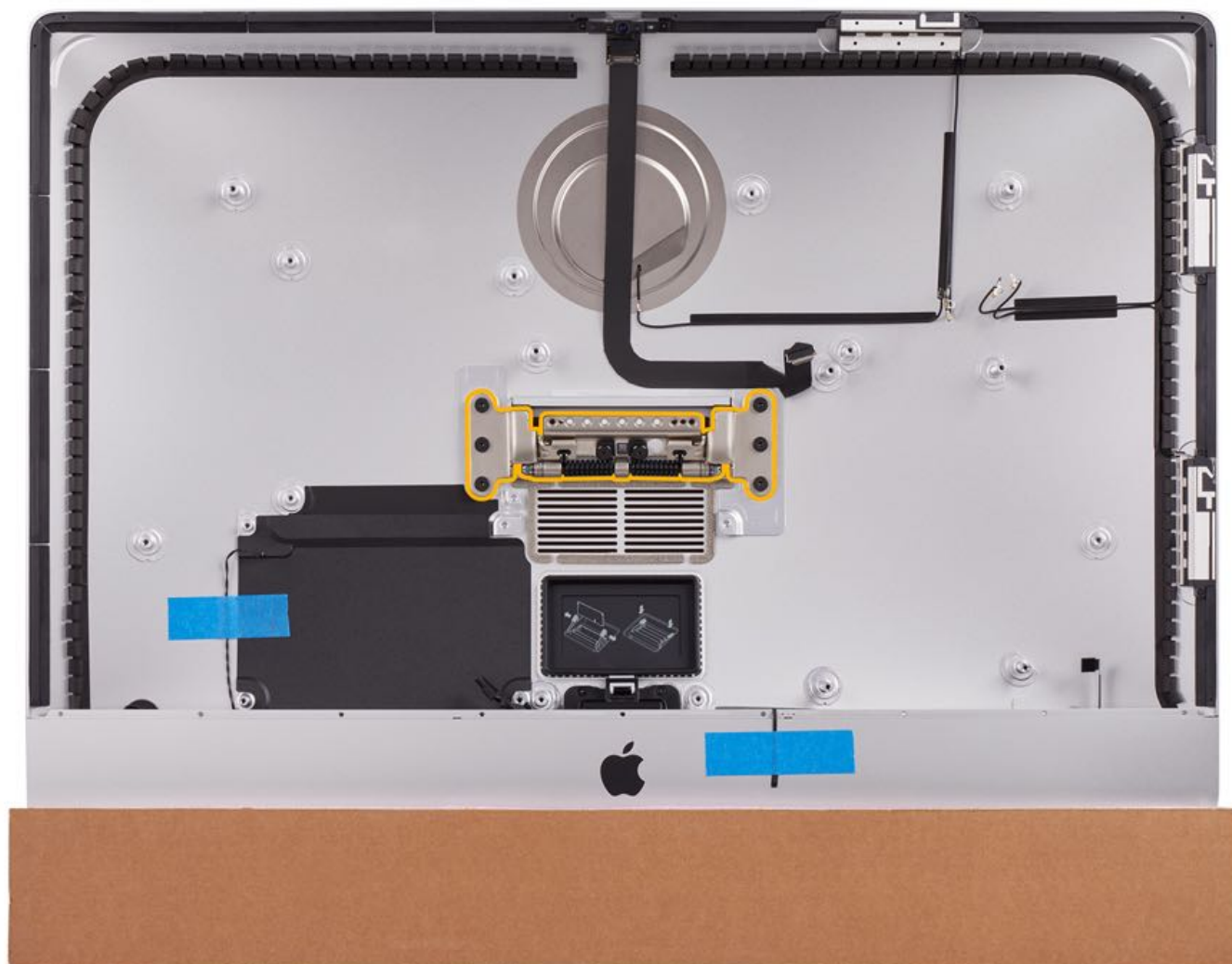
Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

Remove:

- [Display](#)
- [Fan](#)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#)
- [Power supply](#)
- [Logic board](#)
- [Stand](#) (stand mechanism only)

This article includes removal and reassembly steps for the mechanism and the memory door lock mechanism.

Stand Mechanism:



Memory Door Lock Mechanism:



Tools

1. Torx T5 screwdriver
2. Torx T10 screwdriver
3. LCD service support stand (923-0416)



Steps For Removal

Stand Mechanism:

1. Place the rear housing in the display support stand.
2. Remove six T10 screws and lift the mechanism off of the rear housing.



Memory Door Lock Mechanism:

1. Remove four T5 screws from the memory door lock mechanism and lift it off of the rear housing.



Steps For Reassembly

Stand Mechanism:

1. Position the mechanism in the center of the rear housing.

2. Reinstall the six T10 (923-0334) screws in the order shown in the image.

Important: Ensure the hinge is fully seated.



Memory Door Lock Mechanism:

1. Position the memory door lock mechanism in the rear housing.
2. Reinstall the four T5 (923-0404) screws in the lock mechanism.





Reinstall the following parts to complete reassembly:

3. Reinstall the [stand](#).
4. Reinstall the [logic board](#).
5. Reinstall the [power supply](#).
6. Reinstall the [right speaker](#).
7. Reinstall the [hard drive](#).
8. Reinstall the [left speaker](#).
9. Reinstall the [fan](#).
10. Reinstall the [display](#).

iMac (Retina 5K, 27-inch, 2019) Rear Housing

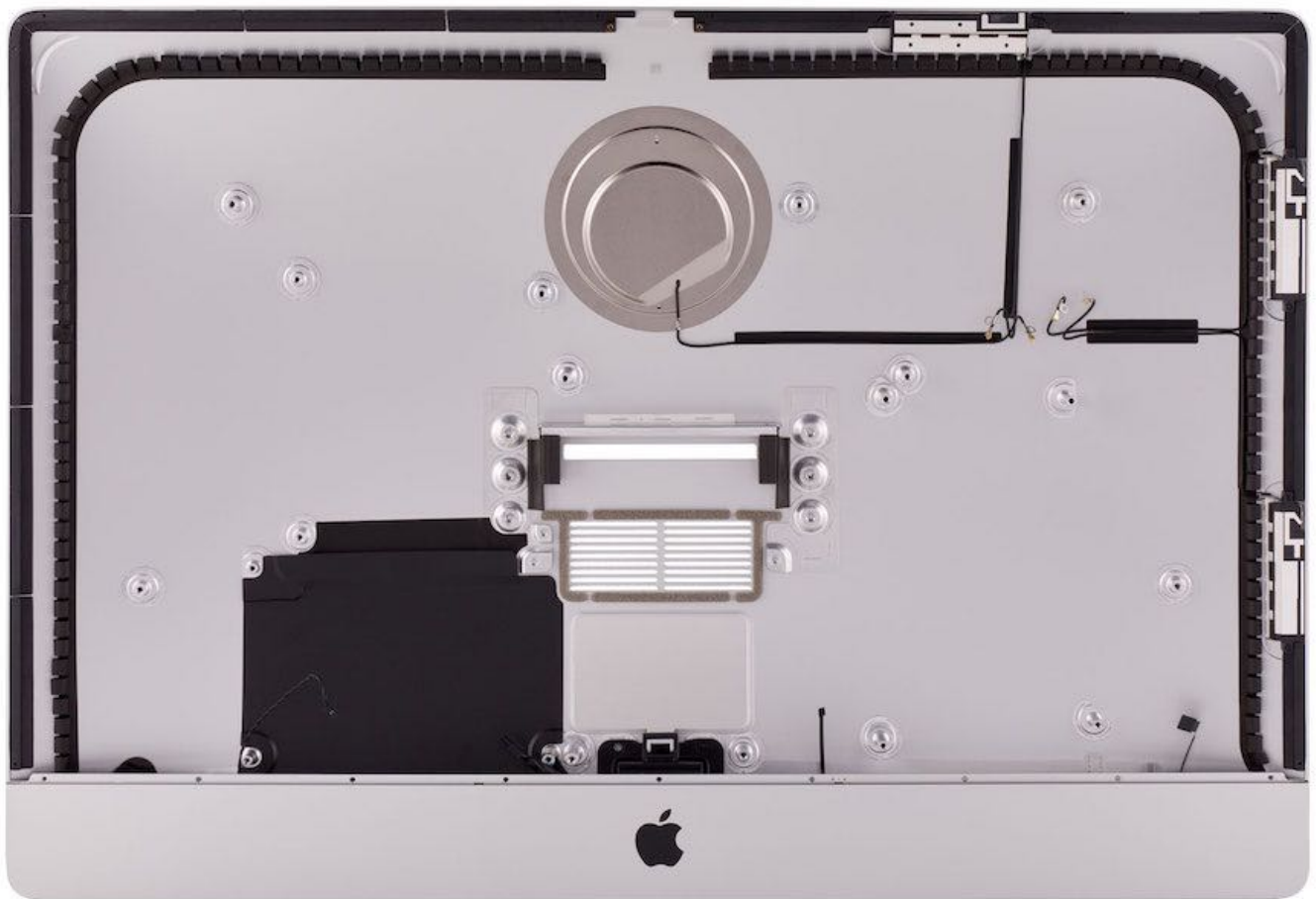
First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About AppleCare service certifications](#).

Remove:

- [Display](#)
- [Camera](#)
- [Fan](#)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#)
- [Power supply](#)
- [Logic board](#)
- [Antennas](#)
- [Stand](#)
- [Mechanism](#)

Note: After you have removed the parts listed above, the rear housing is the only remaining part.



Tools

1. Antistatic, lint-free cloth
2. Torx T25 screwdriver



Steps For Removal

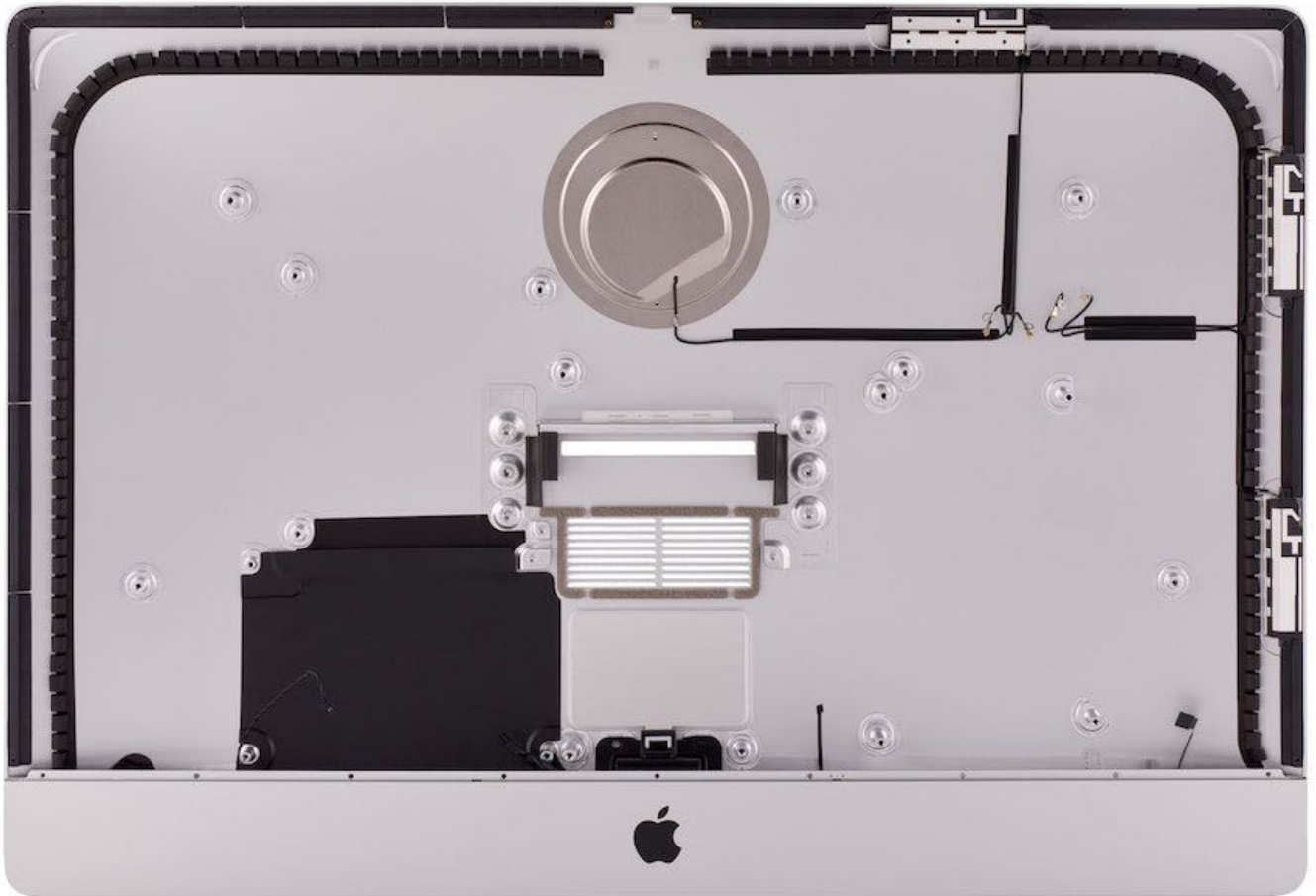
1. Place the rear housing on a soft cloth to avoid scratching.

The rear housing includes the following removable parts, which are available separately:

- Mechanism (923-03066)
- Mechanism screws (923-0334)
- Memory cover (923-03069)
- Memory cover lock mechanism (923-01735)
- Memory cover lock mechanism screws (923-0404)
- Chin strap (923-01671)
- Chin strap screws (923-0338), package of 9
- T25 power supply standoff screw (923-0520)
- T25 hard drive bracket standoff screw (923-0521)

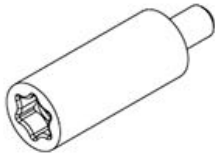
The rear housing includes the following nonremovable parts, which are not available separately:

- Wi-Fi antenna (in silver circle behind Apple logo)
- Microphone flex cable
- Audio board and flex cable
- Power button and cable
- AC inlet
- Airloop gasket



Steps For Reassembly

1. If you are replacing the rear housing, transfer the right hard drive bracket, the hard drive bracket standoff screw (1), and the power supply standoff screw (2) to the replacement rear housing.
 - 1 = T25 hard drive bracket standoff screw, 923-0521



- 2 = T25 power supply standoff screw, 923-0520

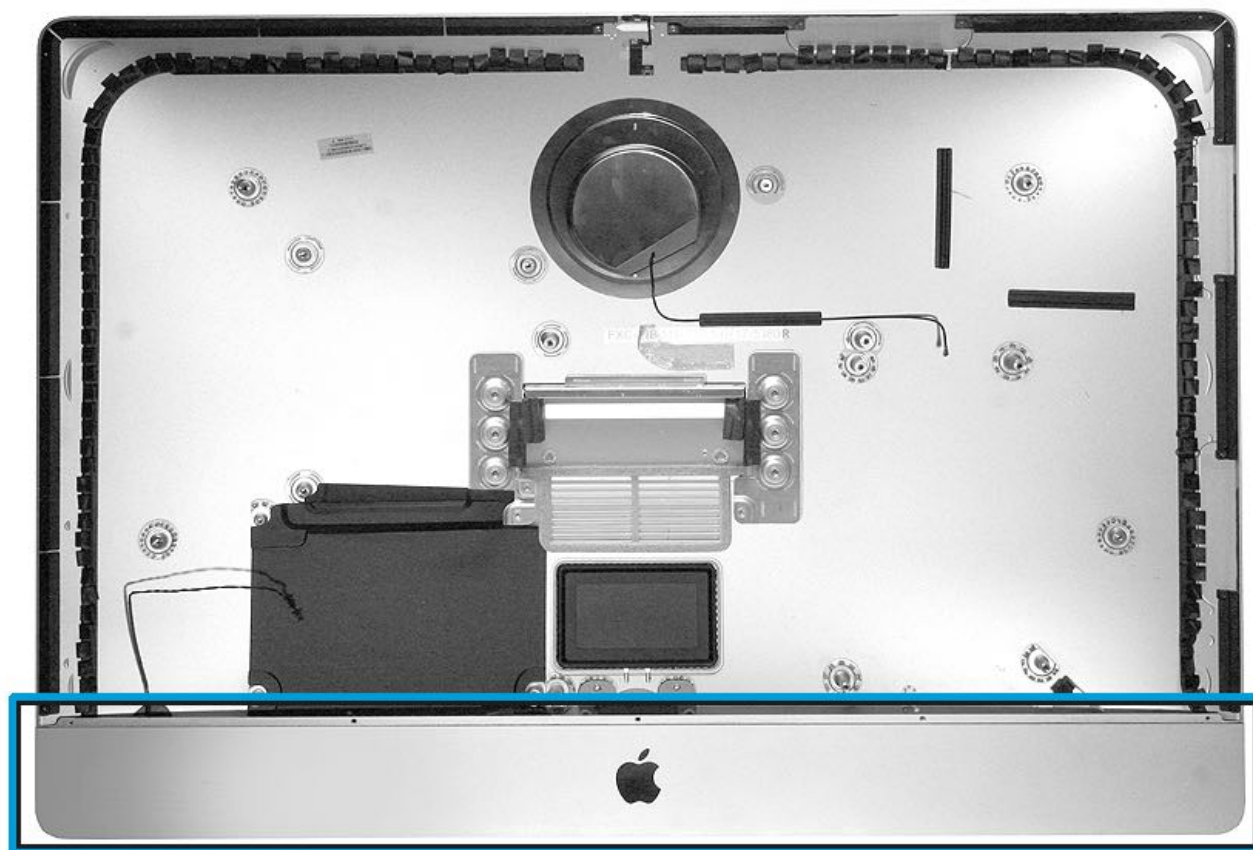


2. Transfer the Bluetooth antenna (upper antenna) and two Wi-Fi antennas (middle and lower antennas) to the rear housing.
3. Route the antennas under the insulator tape or Mylar tape.

Note: If the insulator tape or Mylar tape no longer adheres to the rear housing, use Kapton tape to secure the antennas.
4. Reinstall the [mechanism](#).
5. Reinstall the [stand](#).
6. Reinstall the [antennas](#).
7. Reinstall the [logic board](#).
8. Reinstall the [power supply](#).
9. Reinstall the [right speaker](#).
10. Reinstall the [hard drive](#).
11. Reinstall the [left speaker](#).
12. Reinstall the [fan](#).
13. Reinstall the [camera](#).
14. Reinstall the [display](#).



Caution: Always handle the rear housing with two hands: one hand on the lower left corner and one hand on the lower right corner. Incorrectly handling the rear housing could bend the aluminum and cause alignment issues.



iMac (2019) Built-in VESA Mount Adapter

First Steps

Important: This procedure should only be performed by Apple-certified technicians. For more information, refer to [OP1859: About Apple service certifications](#).

Note: The VESA mount adapter and VESA tongue are located on the back of the rear housing. Both can be serviced without removing any parts.

Remove the following parts to service the VESA Mechanism Plate and VESA rear housing:

iMac (Retina 4K, 21.5-inch, 2019)	iMac (Retina 5K, 27-inch, 2019)
Display	Display
Fan	Fan
Hard Drive	Left Speaker
Left Speaker	Right Speaker
Right Speaker	Hard Drive
Power Supply	Power Supply
Logic Board	Logic Board



Tools

1. Torx T8 screwdriver
2. Torx T10 screwdriver
3. iMac LCD service support stand (923-0416)

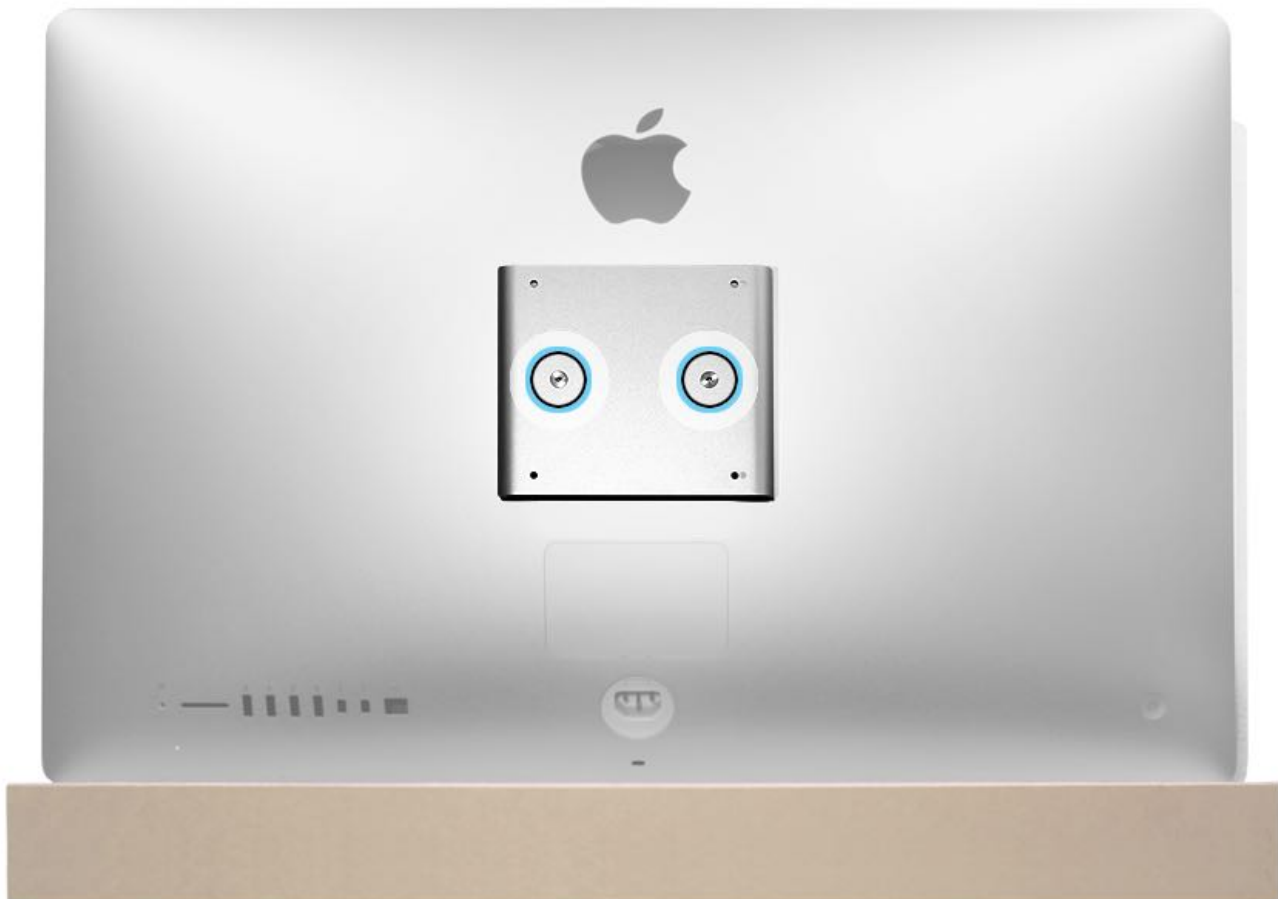


Steps For Removal

VESA Mount Adapter and VESA Tongue

Note: The VESA mount adapter and VESA tongue are located on the back of the rear housing. Both can be serviced without removing any parts.

1. Place the rear housing on LCD support stand, with the VESA mount adapter facing you.
2. Remove two pentalobe screws.
3. Lift the VESA mount adapter off of the VESA tongue.



4. Pull the VESA tongue off of the rear housing.

Note: The computer serial number is on the underside of the VESA tongue.



VESA Mechanism Plate

1. Place the rear housing on the LCD support stand, with the VESA mechanism plate facing you.
2. Remove six T10 screws.
Note: There are four T10 screws for the iMac (Retina 4K, 21.5-inch, 2019).
3. Lift the VESA mechanism plate off of the rear housing.



VESA Rear Housing

With all modules removed, the rear housing is the remaining part.

VESA rear housing:

- 923-01616: iMac (Retina 4K, 21.5-inch, 2019)
- 923-01667: iMac (Retina 5K, 27-inch, 2019)

A VESA rear housing includes the following parts, which are **not** available separately:

- Wi-Fi antenna in silver circle behind Apple logo
- microphone flex cable
- power button and cable
- AC inlet
- audio input/output cable
- gaskets
- wireless antenna insulators

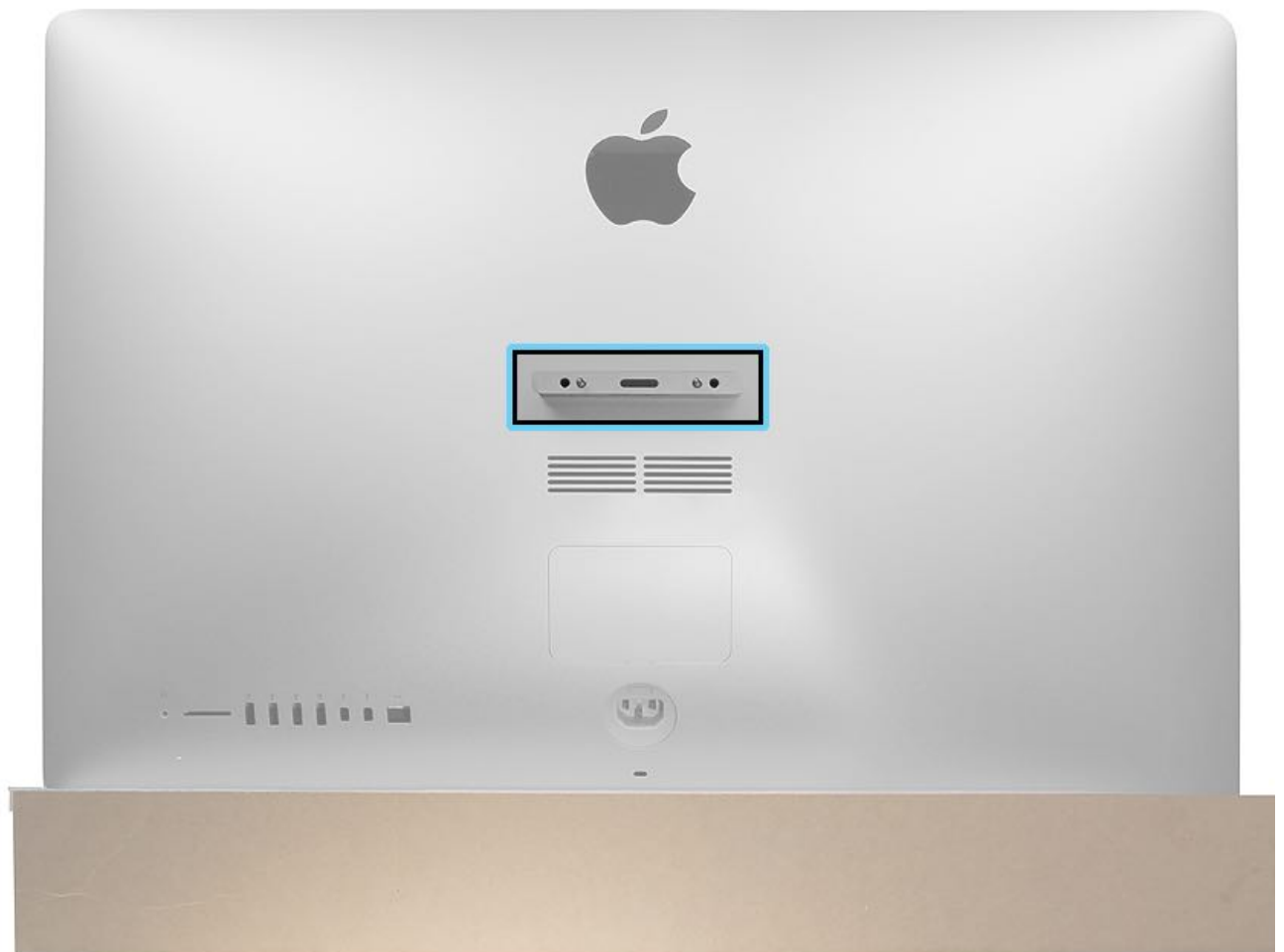
A VESA rear housing includes the parts listed below, which are available separately. For additional part information, refer to the exploded view and screw chart of the model you are repairing.

- [Exploded View and Screw Chart for iMac \(Retina 4K, 21.5-inch, 2019\)](#)
- [Exploded View and Screw Chart for iMac \(Retina 5K, 27-inch, 2019\)](#)
- RAM door
- RAM door lock mechanism and screws
- VESA mechanism plate screws
- Chin strap
- Chin strap screws
- T25 PSU standoff (27-inch model only)
- T25 HDD standoff (27-inch model only)

Steps For Reassembly

VESA Tongue and VESA Mount Adapter

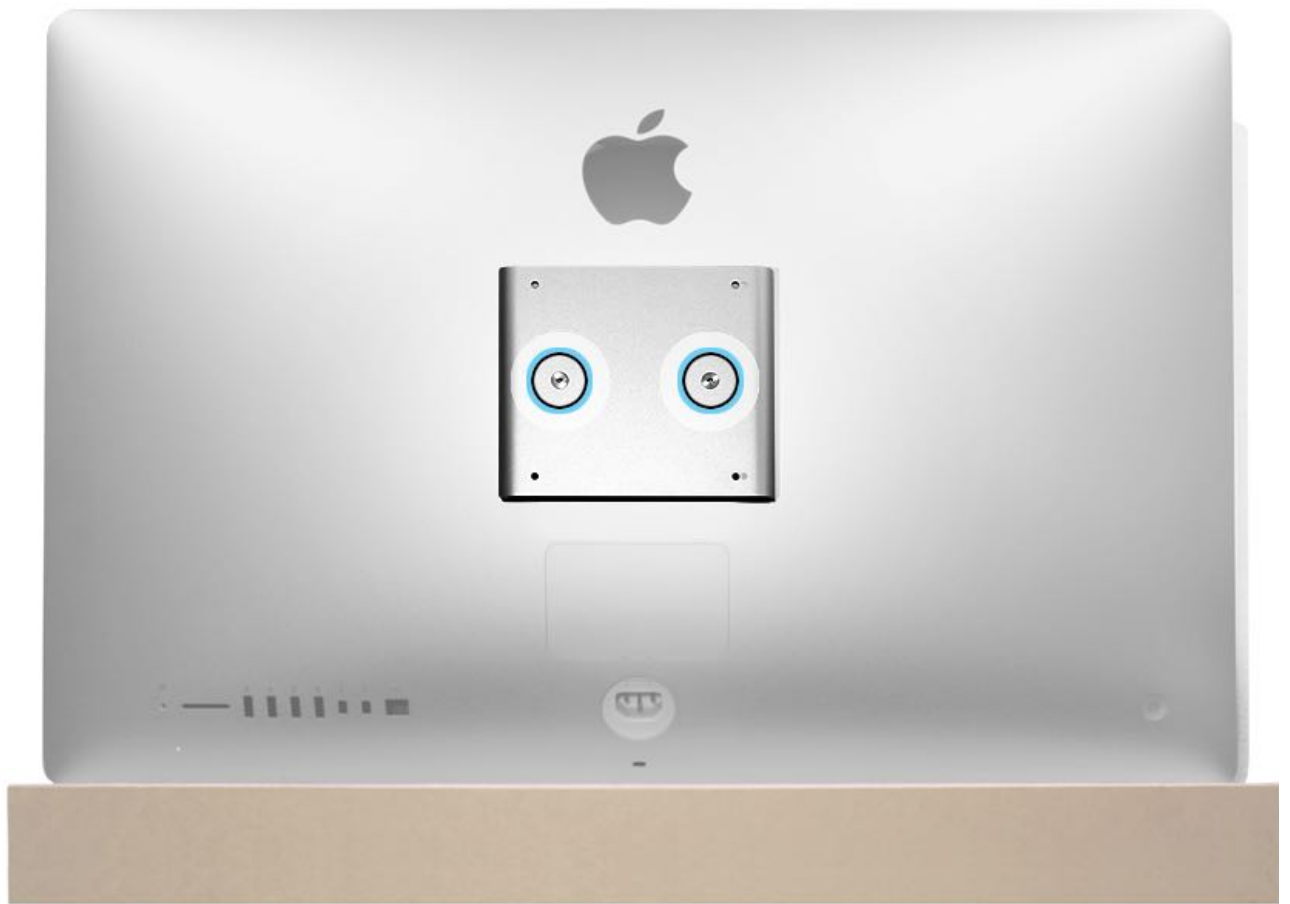
1. Insert the VESA tongue into the opening on the rear housing.



1.

2. Align the screws holes on the VESA mount adapter with the screw holes on the VESA tongue.
3. Install two pentalobe screws.
 - VESA pentalobe: 923-0418





VESA Mechanism Plate

1. Position the mechanism plate in the rear housing.
2. Reinstall the six T10 screws.

Note: There are four T10 screws for the iMac (Retina 4K, 21.5-inch, 2019).

- T10: 923-0334





3. Follow the list of required removal procedures in reverse order to complete the repair.

VESA Rear Housing

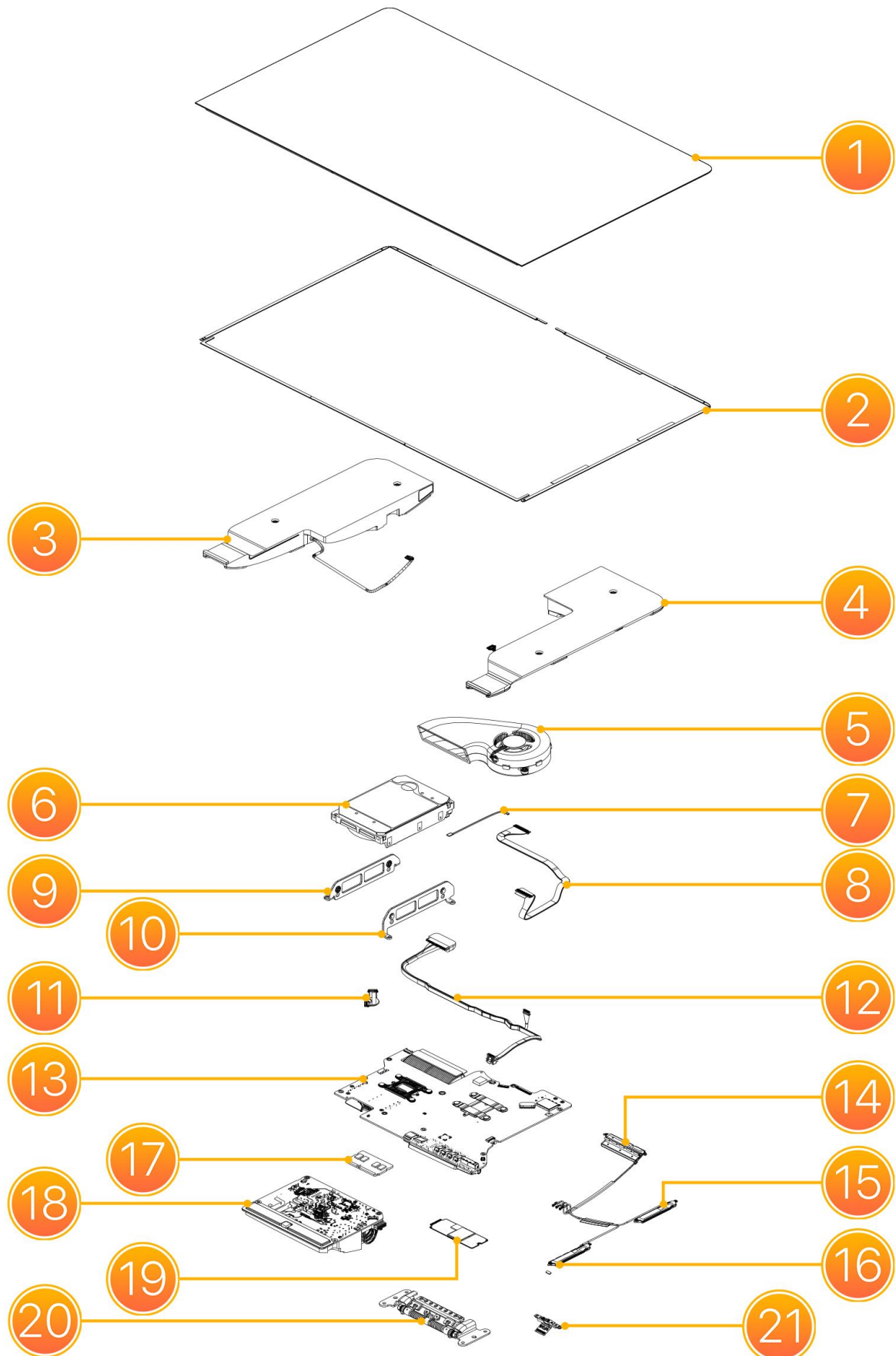
1. Reinstall the VESA Mechanism Plate.
2. Reinstall the VESA Tongue and VESA Mount Adapter.
3. Follow the list of required removal procedures in reverse order to complete the repair.

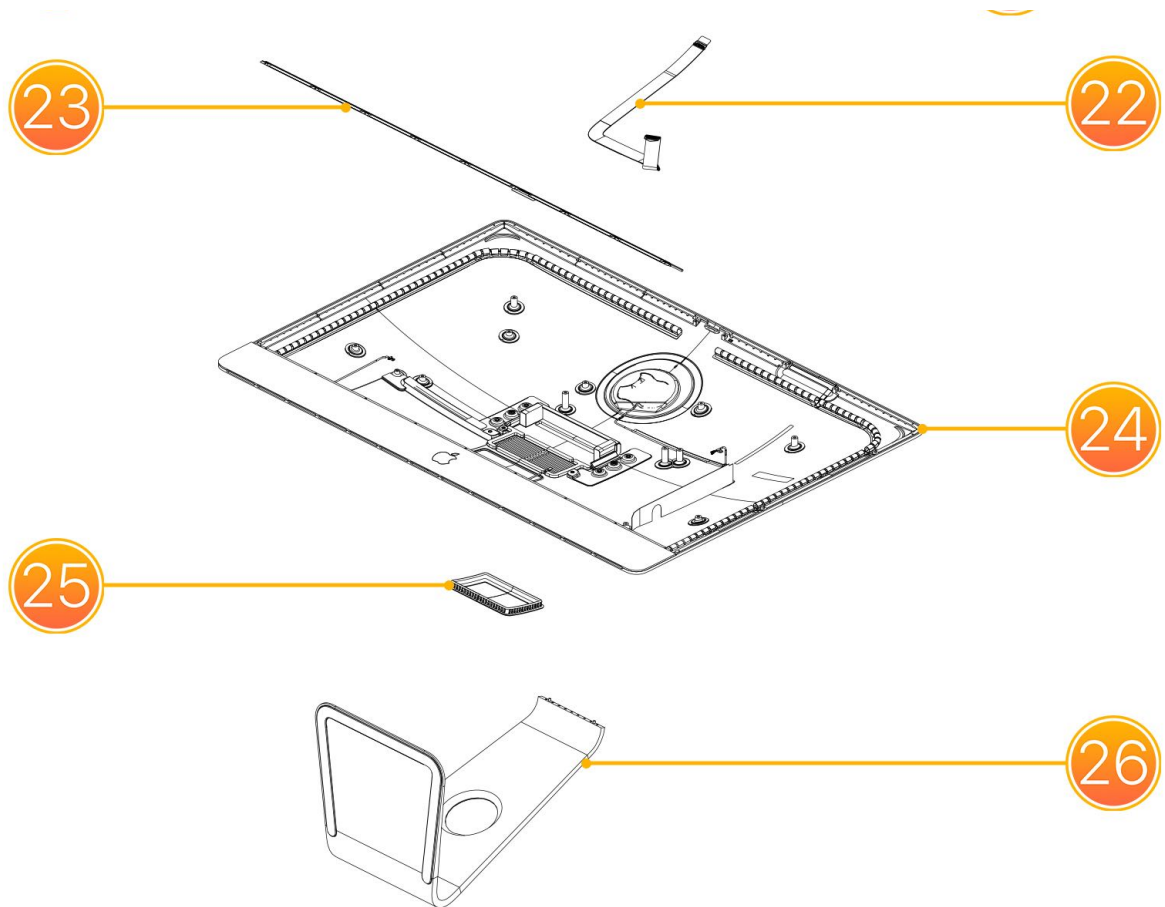
iMac (Retina 5K, 27-inch, 2019) Exploded View and Screw Chart

This article includes the following sections:

- Exploded View
- Screw Chart

Exploded View for iMac (Retina 5K, 27-inch, 2019)





1. Display Panel

- 661-12558

2. Display Adhesive (VHB)

- See [TP818: Required Tools](#)
- 076-00330, LCD Starter Kit
- 076-00332, Refill Kit

3. Left Speaker (Pair)

- 923-03072

4. Right Speaker (Pair)

- 923-03072

5. Fan

- 923-03071

6. Hard Drive

- 661-12544, 1TB
- 661-12545, 2TB
- 661-12546, 3TB

7. Display Thermal Sensor Cable

- 923-0310

8. Embedded DisplayPort (eDP) Cable

- 923-01668

9. Hard Drive Bracket, Left

- 923-00086

10. Hard Drive Bracket, Right

- 923-00087

11. Power Signal Cable

- 923-0311

12. Hard Drive Data and Power Cable

- 923-00664

13. Logic Board

661-12459: 3.0GHz 6-core Intel Core i5, Radeon Pro 570X, FCC	661-12475: 3.6GHz 8-core Intel Core i9, Radeon Pro 575X, FCC
661-12460: 3.0GHz 6-core Intel Core i5, Radeon Pro 570X, ETSI	661-12476: 3.6GHz 8-core Intel Core i9, Radeon Pro 575X, ETSI
661-12461: 3.0GHz 6-core Intel Core i5, Radeon Pro 570X, ROW	661-12477: 3.6GHz 8-core Intel Core i9, Radeon Pro 575X, ROW
661-12463: 3.1GHz 6-core Intel Core i5, Radeon Pro 575X, FCC	661-12479: 3.6GHz 8-core Intel Core i9, Radeon Pro 580X, FCC
661-12464: 3.1GHz 6-core Intel Core i5, Radeon Pro 575X, ETSI	661-12480: 3.6GHz 8-core Intel Core i9, Radeon Pro 580X, ETSI
661-12465: 3.1GHz 6-core Intel Core i5, Radeon Pro 575X, ROW	661-12481: 3.6GHz 8-core Intel Core i9, Radeon Pro 580X, ROW
661-12467: 3.7GHz 6-core Intel Core i5, Radeon Pro 580X, FCC	661-12483: 3.6GHz 8-core Intel Core i9, Radeon Pro Vega 48, FCC
661-12468: 3.7GHz 6-core Intel Core i5, Radeon Pro 580X, ETSI	661-12484: 3.6GHz 8-core Intel Core i9, Radeon Pro Vega 48, ETSI
661-12469: 3.7GHz 6-core Intel Core i5, Radeon Pro 580X, ROW	661-12485: 3.6GHz 8-core Intel Core i9, Radeon Pro Vega 48, ROW
661-12471: 3.7GHz 6-core Intel Core i5, Radeon Pro Vega 48, FCC	
661-12472: 3.7GHz 6-core Intel Core i5, Radeon Pro Vega 48, ETSI	
661-12473: 3.7GHz 6-core Intel Core i5, Radeon Pro Vega 48, ROW	

14. Bluetooth Antenna

- 923-00665

15. Middle Wi-Fi Antenna

- 923-00667

16. Lower Wi-Fi Antenna

- 9223-00668

17. Memory

- 661-12453, 4GB, DDR4, 2666MHz
- 661-12454, 8GB, DDR4, 2666MHz
- 661-12455, 16GB, DDR4, 2666MHz

18. Power Supply, 300W

- 661-12714

19. Flash Storage

- 661-12548, 32GB
- 661-12549, 128GB
- 661-12550, 256GB
- 661-12551, 512GB
- 661-12552, 1TB

- 661-12553, 2TB

20. Mechanism

- 923-03066

21. Camera

- 923-001680

22. Camera Cable

- 923-03070

23. Chin Strap

- 923-01671

24. Rear Housing

- 923-03064
- 923-03065, VESA

25. Memory Door

- 923-03069

5. Stand

- 923-03067

Not shown:

- 923-02330, Antenna Cowling
- 923-01735, Memory Door Lock Mechanism
- 923-00657, VESA Mechanism Plate
- 923-03068, VESA Tongue
- 923-0424, VESA Mount Bracket

Screw Chart for iMac (Retina 5K, 27-inch, 2019)

Note: Screws are not to scale.

<p>923-0304 T4</p>  <p>Bluetooth antenna (2) Middle Wi-Fi antenna (2) Lower Wi-Fi antenna (2)</p>	<p>923-0331 T8</p>  <p>Logic board (5) Power supply (2) Hard drive bracket (3)</p>	<p>923-0333 T10</p>  <p>Right speaker (2) Left speaker (2)</p>
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923-0334 T10  Mechanism (6)	923-0336 T8  Flash storage (1)	923-0338 Phillips #00  Chin strap (9)
923-0339 T5  Camera (2)	923-0395 T10  Heat sink (2)	923-0396 T8  Power supply (2) Logic board (3)
923-0399 T25  Power supply standoff (1)	923-0404 T5  Memory door lock mechanism (4)	923-0418 Pentalobe  VESA Mount (2)
923-0520 T25  Power supply standoff (1)	923-0521 T25  Hard drive standoff (1)	923-00529 T8  Stand (9)
923-00669 T10  Fan (3)	923-00767 T8  Logic board (1)	923-01675 T8  Hard drive mounting pins (4)

923-02294

T5



Antenna cowling (2)

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